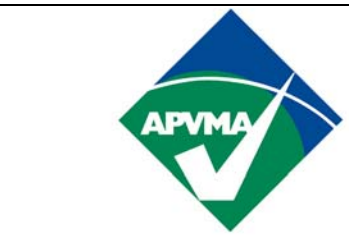

Australian Pesticides &
Veterinary Medicines Authority

The reconsideration of registrations of products containing carbaryl and their associated labels

Part 1:

Uses of carbaryl in home garden, home veterinary, poultry and domestic situations

REVIEW FINDINGS

APRIL 2006

These are the findings of the review of carbaryl for products used in home garden, home veterinary, poultry and domestic situations.
They form the basis for regulatory action to be taken by the APVMA.

Australian Pesticides &
Veterinary Medicines Authority

Canberra
Australia

This review report for products containing carbaryl is published by the Australian Pesticides & Veterinary Medicines Authority. For further information about this review or the Pesticides Review Program, contact:

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FOREWORD

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

The APVMA can reconsider the approval of an active constituent, the registration of a chemical product or the approval of a label for a container for a chemical product at any time. This is outlined in Part 2, Division 4 of the Agvet Codes.

The basis for the current reconsideration is whether the APVMA is satisfied that continued use of products containing carbaryl in accordance with the instructions for their use:

- would not be an undue hazard to the safety of people exposed to it during its handling or people using anything containing its residues; and/or
- would not be likely to have an effect that is harmful to human beings.

The requirements for continued approval of a label for containers for a chemical product are that the label contains adequate instructions. Such instructions include:

- the circumstances in which the product should be used
- how the product should be used
- times when the product should be used
- frequency of the use of the product
- the withholding period after the use of the product
- disposal of the product and its container
- safe handling of the product.

A reconsideration may be initiated when new research or evidence has raised concerns about the use or safety of a particular chemical, a product, or its label.

The reconsideration process includes a call for information from a variety of sources, a review of that information and, following public consultation, a decision about the future use of the chemical or product.

In undertaking reconsiderations (hereafter referred to as reviews), the APVMA works in close cooperation with advisory agencies including the Department of Health and Ageing's Office of Chemical Safety, the Department of the Environment and Heritage, and state departments of agriculture as well as other expert advisers, as appropriate.

The APVMA has a policy of encouraging openness and transparency in its activities and community involvement in decision-making. The publication of review reports is a part of that process.

The APVMA also makes these reports available to the regulatory agencies of other countries as part of bilateral agreements. The APVMA recommends that countries receiving these

[*] Prior to March 2003, the APVMA was known as the National Registration Authority for Agricultural and Veterinary Chemicals (NRA). In this report, the name APVMA is generally used even when referring to the organisation prior to March 2003.

reports will not utilise them for registration purposes unless they are also provided with the raw data from the relevant applicant.

This document sets out the review findings relating to products containing carbaryl and their labels used in home garden, home veterinary, poultry and domestic situations, that have been nominated for review by the APVMA. The review's findings and recommendations are based on information collected from a variety of sources. The information and technical data required by the APVMA to review the safety of both new and existing chemical products must be derived according to accepted scientific principles, as must the methods of assessment undertaken.

ACRONYMS AND ABBREVIATIONS

ac	active constituent
ACPH[1]	Advisory Committee on Pesticides and Health
ADI	Acceptable daily intake
ai	Active ingredient
ARfD	Acute Reference Dose
BA	2-bromoacrolein
CCPR	Codex Committee on Pesticide Residues
ChE	Cholinesterase
CODEX	FAO/WHO Codex Alimentarius Commission
CRP	Chemistry and Residues Program
DEH	Department of the Environment and Heritage (previously Environment Australia)
DoC	Declaration of composition
EHC	Environmental health criteria
F0	Parental generation
F1	Filial generation, first
F2	Filial generation, second
FAISD	Handbook of First Aid Instructions, Safety Directions, Warning Statements and General Safety Precautions for Agricultural and Veterinary Chemicals
FAO	Food and Agriculture Organization
FSANZ	Food Standards Australia New Zealand
GAP	Good agricultural practice
GLP	Good laboratory practice
ha	hectare
HG	Home garden
HR	Highest residue
HV	Home veterinary
IRED	Interim re-registration eligibility decision
JMPR	Joint FAO/WHO Meeting on Pesticide Residues
LD_{50}	Median lethal dose
LOAEL	Lowest observable adverse effect level
LOEL	Lowest observable effect level
mg/kg bw/d	milligrams/ kilogram bodyweight/day
MOE	Margin of Exposure
MoS	Margin of safety
MRL	Maximum residue limit
NEDI	National estimated daily intake
NESTI	National estimated short-term intake
NHMRC	National Health and Medical Research Council
NOAEL	No observed adverse effect level
NOEC	No observed effect concentration
NOEL	No observed effect level
NOHSC[2]	National Occupational Health and Safety Commission
NRS	National Residue Survey
OCS	Office of Chemical Safety
OHS	Occupational health and safety
PACSC	Pesticide and Agricultural Chemical Standing Committee
PHED	Pesticide Handlers Exposure Database
PHI	Post harvest interval
POEM	Predictive Operator Exposure Model
PPE	Personal protective equipment

[1] The ACPH last sat in 2003. It has recently been superseded by the Advisory Group on Chemical Safety (AGCS)

[2] Occupational health and safety assessments that were conducted by NOHSC are now conducted by OCS

ppm	Parts per million
RAC	Raw agricultural commodity
RBC	Red blood cell
SC	Suspension concentrate
STMR	Supervised Trial Median Residue
SUSDP	Standard for the Uniform Scheduling of Drugs and Poisons
T/A	Trading as
TMRL	Temporary MRL
TRR	Total radioactive residues
WHO	World Health Organization
WHP	Withholding period
WP	Wettable powder

CONTENTS

EXECUTIVE SUMMARY

Introduction

The APVMA has reviewed registered products containing carbaryl and the associated label approvals. This Review Findings report summarises the data evaluated and the proposed recommendations from the review of the uses of carbaryl in home garden, home veterinary, poultry and domestic products. One commercial use of carbaryl—in poultry—is also included in this report. The poultry use is included because the product label includes home veterinary uses.

All references to carbaryl in this document refer to carbaryl products used in home garden, home veterinary, poultry and domestic situations. A Preliminary Review Findings (PRF) report on the uses of carbaryl in agricultural situations (Part 2) will be released after the assessment of these uses is completed.

Carbaryl is a carbamate insecticide that is used for the control of insect pests in home garden and domestic situations, on ornamentals, lawns, fruit and vegetables and around public buildings. To a lesser extent it is also used in the control of insects on domestic animals. Formulations of carbaryl include emulsifiable concentrates, suspension concentrates, aqueous concentrates, wettable powders, ready-to-use dusts, ready-to-use liquids and solid formulations. There are currently 38 registered products containing the active constituent carbaryl that are used in home garden and domestic situations (refer Appendix A).

The review of carbaryl was initiated in 1995 to reconsider the maximum residue limits (MRLs) in cereals and also to establish MRLs for animals that may be fed on treated cereal products. In 1999, the toxicology review identified the potential for excessive human exposure to carbaryl. This was considered to have implications for exposure of consumers through use of carbaryl in the home garden. The scope of the review was extended to reconsider whether the uses of products containing carbaryl as home garden or home veterinary applications would have an effect that was harmful to human beings. This extension included associated product labels. The scope of the review was extended a second time in June 2003, when concerns over the implications of acute dietary intake of carbaryl were identified following the establishment of a new acute reference dose (ARfD) for carbaryl.

Toxicological assessment

The toxicological assessment for the review of carbaryl was undertaken by the Office of Chemical Safety (OCS), which considered all the toxicological data and information submitted for the review. The APVMA has considered the advice received from the OCS and makes the following recommendations relating to the continued use of home garden, home veterinary, poultry and domestic products containing carbaryl.

Based on the data provided, the APVMA is satisfied that the use of registered carbaryl products in pet shampoos, 1 per cent ready-to-use liquid sprays and home veterinary ear drops would not be likely to be an undue hazard to the safety of people exposed to it during its handling or have an effect that is harmful to human beings. However, product labels are considered to not contain the required warning statements and safety directions, therefore labels are to be varied to meet the required standards.

Based on the data provided it was found that user exposure from home veterinary dust preparations for the treatment of companion animals and birds is likely to exceed the acceptable daily intake (ADI) and recommended acute reference dose (ARfD). Revised warning statements and enhanced personal protective equipment are not likely to be effective in protecting users from absorbing systemic doses of carbaryl. Therefore, the APVMA cannot be satisfied that home veterinary dust preparations intended for the treatment of companion animals and birds would not be an undue hazard to the safety of people exposed to it during its handling and would not have an effect that is harmful to human beings. It is recommended that the registrations and label approvals of these products be cancelled.

Insufficient data were received and no further data were provided or generated to enable an assessment of householder exposure and ensure an adequate margin of safety for carbaryl dusts for treatment of carpets, rugs and animal bedding. Therefore, the APVMA cannot be satisfied that products containing carbaryl for these domestic uses would not be an undue hazard to the safety of people exposed to it during its handling and would not have an effect that is harmful to human beings. It is recommended that the registrations and label approvals of these products be cancelled.

The APVMA considers that any product with an acute oral LD_{50} of 1500 mg/kg bw or less is not suitable for domestic/home garden use, because of the toxicological risk. It was found that products containing carbaryl and marketed as 800 g/kg wettable powder and liquids containing 400 and 500 g/L carbaryl are above this safety threshold. Therefore, the APVMA cannot be satisfied that domestic/home garden products with a maximum carbaryl concentration of greater than 160 g/kg (or g/L), would not be an undue hazard to the safety of people exposed to it during its handling and would not be likely to have an effect that is harmful to human beings. Therefore, because of the unacceptable risk, it is recommended that the registrations and label approvals of these products be cancelled. The concentration of domestic/home garden products will be restricted to a maximum carbaryl concentration of 160 g/kg (or g/L).

The toxicological assessment concluded that insufficient data were received and no further data were provided or generated to determine user exposure from home garden uses of carbaryl on food-producing plants. There were also insufficient data available to ensure dietary intake would not exceed the acute reference dose. Therefore, the APVMA cannot be satisfied that such uses would not be an undue hazard to the safety of people exposed to it during its handling and would not be likely to have an effect that is harmful to human beings. It is recommended that uses of carbaryl on food-producing plants in the home garden be deleted and product labels be varied. For products registered exclusively for these uses it is recommended that registrations and label approvals be cancelled.

Residues assessment

The residues assessment for the review of carbaryl was undertaken by the APVMA Chemistry and Residues Program (CRP), which considered all the residue data and information submitted for the review of carbaryl. The APVMA has considered the advice received from the CRP and makes the following recommendations relating to the continued use of home garden and poultry products containing carbaryl.

One carbaryl product is registered for a direct treatment to poultry. Insufficient data were received and no further data were provided or generated to assess residues in poultry from

direct animal treatment. Therefore, the APVMA cannot be satisfied that the use of the product in accordance with the instructions for its use would not result in residues in poultry commodities exceeding the limits established or that the use of the product would not be an undue hazard to the safety of people using anything containing its residues. Other uses of the product as companion animal dust are also not supported on toxicological grounds. Therefore, it is recommended that the registrations and label approvals of these products be cancelled.

Insufficient data were received and no further data were provided or generated to enable the assessment of residues in some fruit and vegetables grown in the home garden, including tropical fruit (both edible and inedible peel varieties), citrus fruits (except oranges), brassica vegetables (except cabbage, broccoli and cauliflower), cucurbit vegetables (except cucumber, cantaloupe, bottle gourd and zucchini), carrots and parsnips, pulses, bulb vegetables and stalk and stem vegetables. Therefore, the APVMA cannot be satisfied that use of carbaryl products on the above fruit and vegetable crops would not be an undue hazard to the safety of people using anything containing its residues. Instructions for use on the above crops identified as having insufficient data are to be deleted from labels. It is recommended that some product labels be varied. For products registered exclusively for these uses it is recommended that their registrations and label approvals be cancelled.

Sufficient data were received to enable the assessment of residues in some fruit and vegetables grown in the home garden including grapes, oranges, pome fruit (late pre-harvest applications only), stone fruits, cabbage, broccoli and cauliflower, cucumber, cantaloupe, bottle gourd and zucchini, leafy vegetables and fruiting vegetables. Because of unacceptable residues and acute dietary risk, the APVMA cannot be satisfied that use of carbaryl products on these fruit and vegetable crops would not be an undue hazard to the safety of people using anything containing its residues. It is recommended that product labels be varied. For products registered exclusively for these uses it is recommended that their registrations and label approvals be cancelled.

Based on the submitted data the APVMA is satisfied that continued use of registered carbaryl products on raspberries, beetroot, potato, sugarbeet, turnips (Swede) would not be an undue hazard to the safety of people using anything containing its residues. However, becaused of the potential for unrestricted use in the home garden, these products could pose a toxicological hazard and therefore, these use patterns be removed from home garden product labels.

Proposed final review recommendations

After consideration of all data, the APVMA proposes the following regulatory actions:

a) Vary label approvals.

   Label variations to satisfy the requirements for continued registration of products are as follows:

   - update warning statements and safety directions
   - delete uses where unacceptable risks were identified
   - add new label statements to home garden products as a result of unacceptable exposure risk.

b) Affirm product registrations.

If the proposed label variations are made then the registrations for 12 products can be affirmed, as they would not be an undue hazard to the safety of people exposed to it during its handling or people using anything containing its residues.

c) Cancel product registrations and label approvals.

The APVMA proposes the following product cancellations:

- carbaryl-based home veterinary dusts registered for the treatment of animals and birds
- a carbaryl-based treatment for poultry
- carbaryl dusts for treatment of carpets, rugs and animal bedding
- products containing 800 g/kg wettable powder and liquids containing 400 and 500 g/L carbaryl for use in domestic/home garden situations
- carbaryl (all forms) for indoor use on domestic premises
- carbaryl products used on food producing plants in the home garden
- previously approved labels of currently registered products that are considered not to contain adequate instructions.

The APVMA is not satisfied that the requirements for continued registration of 22 products continue to be met and variations cannot be made so that the requirements for continued registration will be complied with; hence it is proposed that these 22 registrations and approvals be cancelled.

Cancellations as a consequence of review findings

As a consequence of the review findings, the APVMA, having regard to the matters referred to in subsection 14 (5) of the Agvet Codes, makes the following recommendation for the continued use of or any other dealing with four products registered after the commencement of the extended scope of the review. These products containing carbaryl are for use in the home garden and domestic situations. The APVMA is not satisfied that four products would not be an undue hazard to the safety of people exposed to it during its handling or people using anything containing its residues and would not be likely to have an effect that is harmful to human beings. Therefore, on this basis, the registrations and approvals for these products are to be cancelled under section 41 of the Agvet Codes.

1. INTRODUCTION

The APVMA has reviewed registered products containing carbaryl and their associated label approvals. This Review Findings document summarises the data evaluated and the proposed recommendations arising as a result of the review of carbaryl products used in home garden, home veterinary, poultry and domestic situations. One commercial use of carbaryl in poultry, is also included in this report. The poultry use is included because the product label includes home veterinary uses. All references to carbaryl in this document refer to carbaryl products used in home garden, home veterinary, poultry and domestic situations. A Preliminary Review Findings (PRF) report on the uses of carbaryl in agricultural situations will be released after the assessment of these uses is completed.

1.1 Regulatory status of carbaryl in Australia

Carbaryl has been registered in Australia for over 20 years. As at 1 December 2005 there were 38 registered products containing the active constituent carbaryl for use in home garden, home veterinary, poultry and domestic situations (Appendix A). Product formulations contain carbaryl either as the sole active constituent or in combination with other active constituents. Formulations of carbaryl include emulsifiable concentrates, suspension concentrates, aqueous concentrates, wettable powders, ready-to-use dusts, ready-to-use liquids and solid formulations. The formulation types are set out in Table 1. Section 2 of this report provides information on the uses of carbaryl products.

Table 1: Registered formulations of carbaryl under review

Formulation type	Level of active constituent	Product type
Emulsifiable concentrate	500 g/L	Agricultural and home garden insecticide concentrate
	100 g/L	Home garden insecticide concentrate
Suspension concentrate	400–500 g/L	Agricultural and home garden insecticide concentrate
	100 g/L	
Wettable powder	800 g/kg	Agricultural and home garden insecticide
	80–120 g/kg	
Ready-to-use dust	40–50 g/kg	Home garden and commercial bird dusting powder
	50 g/kg	Pet grooming, carpet and pet bedding treatment powder
	18–50 g/kg	Home garden insect bait
	20 g/kg	Agricultural and home garden vegetable dust
	19 g/kg	Home garden flower and vegetable dust
Ready-to-use liquid	0.96 g/L	Home garden insecticide
	2–40 g/L	Pet shampoo
Aqueous concentrate	60 g/L	Domestic lawn insecticide concentrate
	100 g/L	Home garden insecticide concentrate
	400 g/L	
	18 g/kg	Bait pellet
Liquid	10 mg/mL	Ear drop

1.2 Reasons for carbaryl review

In 1993 the maximum residue limits (MRLs) for carbaryl use on cereal crops were withdrawn following a residue assessment that showed that the available Australian residue data were inadequate to support the existing MRLs. Temporary MRLs were put in place at that time to allow trials to be carried out.

Insufficient residue data were subsequently provided to support ratification of the temporary MRLs in relation to the use of carbaryl in cereals, either by field application or for stored grain use. A review was initiated in 1995 to reconsider residues in cereals and also to establish MRLs for animals that may be fed on treated cereal products.

In 1999, toxicology reviewers also identified the potential for excessive human exposure to carbaryl. This was considered to have serious implications for exposure of consumers through use of carbaryl in the home garden. The scope of the review was therefore extended to reconsider whether the uses of products containing carbaryl as home garden and home veterinary applications (and the products' associated labels) would have an effect that was harmful to human beings.

More recently (June 2003) the APVMA extended the scope of the review a second time when concerns over the implications of acute dietary intake of carbaryl were identified.

1.3 Regulatory options

There can be three possible outcomes to the reconsideration of the registration of products containing carbaryl and their labels. Based on the information reviewed the APVMA may be:

- satisfied that the products and their labels continue to meet the prescribed requirements for registration and approval and therefore affirms the registrations and approvals
- satisfied that the conditions to which the registration or approval is currently subject can be varied in such a way that the requirements for continued registration and approval will be complied with and therefore varies the conditions of registration or approval
- not satisfied that the requirements for continued registration and approval continue to be met and suspends or cancels the registration and/or approval.

1.4 Scope of the review

The scope of the review considered the reasons for the nomination of carbaryl, the information already available on this chemical, and the approved uses of the product in Australia.

In light of concerns raised by the Office of Chemical Safety (OCS) and the APVMA, it did not appear that the APVMA could be satisfied that the continued use of or any other dealing with products containing carbaryl in accordance with the approved instructions for use:

- would not be an undue hazard to the safety of people exposed to it during its handling or people using anything containing its residues; and/or
- would not be likely to have an effect that is harmful to human beings.

The APVMA also considered whether product labels carry adequate instructions and warning statements. The requirement for product labels is that the label contains adequate instructions. Such instructions include:

- the circumstances in which the product should be used
- how the product should be used
- the times when the product should be used
- the frequency of the use of the product
- the withholding period after the use of the product
- the disposal of the product and its container
- the safe handling of the product.

On the basis of these concerns, it was appropriate that the registrations and label approvals for carbaryl be subject to reconsideration under Part 2, Division 4, of the Agvet Codes.

The APVMA reviewed the following aspects of product registrations and label approvals for home garden and domestic uses of carbaryl:

- toxicology, including:
    - the potential for home garden, home veterinary and domestic products to cause acute and chronic toxicity, that could be an undue hazard to the safety of people exposed to it during its handling and could have an effect that is harmful to human beings
- residues in food, including:
    - the potential for carbaryl residues
    - the potential for acute and chronic dietary exposure to carbaryl residues in food commodities
    - the potential for consumption of carbaryl residues in food to exceed the ARfD, that may be an undue hazard to the safety of people exposed to carbaryl residues in food.

The APVMA also considered whether product labels carry adequate instructions and warning statements as outlined in Section 1.4 above.

2. APPROVED CARBARYL USE PATTERNS

2.1 Introduction

Carbaryl is a broad spectrum, general purpose carbamate insecticide effective against a range of insects, mites, lice, millipedes and other pests. It is used in home garden, home veterinary, poultry and domestic situations and has a very short persistence.

2.2 Home garden and domestic use patterns of carbaryl products in Australia

Comments received at the commencement of the review indicated that carbaryl is the insecticide of choice for the management of most chewing insect pests in gardens including leafminers, caterpillars, grubs, grasshoppers, mites, aphids and lacewings. It is selectively active and very effective against millipedes, earwigs and pear and cherry slugs. Carbaryl was also highlighted as one of the few chemical products available for the control of Lepidoptera in the home garden and also considered an extremely important chemical for control of black Portuguese millipede (*Ommatoiulus moreletii*), found in home gardens in South Australia and Western Australia.

Home garden products (Table 2) are also reported as being used in nurseries, mainly due to the small amount of chemical used on each occasion with the small pack size also minimising the need for storage of chemicals.

Table 2: Summary of home garden uses of carbaryl products

Crop	Pest	Product description	Application instructions
FRUIT			
Apple, apricot, avocado, citrus, fruit (general), grape, nectarine, peach, pear, plum, prune, stone fruit	Codling moth, light brown apple moth, pearleaf blister mite, borer, native budworm, oriental fruit moth, monolepta beetle, bronze orange bug, weevils, scale, grapeleaf blister mite, pear and cherry slug, green treehopper	WP 80–120 g/kg	Either packed in 60 g measure packs to be diluted into 5L water or use 0.8–1 g/L water.
		AC/SC 100 g/L	Dilute to 1g/L. Spray when insects first appear then every 7–10 days.
		AC 400–500 g/L	Use 1 g/L Spray 3 weeks after petal fall; repeat every 3–4 weeks.
		WP 800 g/kg	Use 1 g/L in water. Apply every 3 weeks from mid September.
VEGETABLES			
Tomato, vegetable (general), broccoli, bean, Brussels sprouts, cabbage, carrot, cauliflower, cucurbit, leafy vegetable, potato, root vegetable, turnip	Aphid, caterpillar, cutworm, blight, mite, leafhopper, thrips, tomato grub, ladybird, cabbage moth, earwig, cabbage white butterfly, weevil, Rutherglen bug, green vegetable bug, leaf spot, russet mite, harlequin bug, helicoverpa, lace bug, potato moth, pumpkin beetle, grasshopper	20 g/kg	Dust lightly over all surfaces every 7–10 days.
		WP 80–120 g/kg	Either packed in 60g measure packs to be diluted into 5L water or use 0.8–1 g/L water. Apply at 7–14 day intervals.
		Ready-to-use liquid 0.96 g/L	Spray plants thoroughly every 7 days.
		AC/SC 100 g/L	Dilute to 1 g/L. Spray when insects first appear then every 7–10 days.
		AC 400–500 g/L	Use 1 g/L ai. Apply at first signs of pest activity.

Crop	Pest	Product description	Application instructions
		WP 800 g/kg	Spray when insects first appear then every 7–10 days.
ORNAMENTALS			
Ornamentals, including: flowers, elm tree in non-crop situations, rose.	Lace bug, budworm, cabbage moth, cabbage white butterfly, caterpillar, cutworm, blight, earwig, green vegetable bug, harlequin bug, helicoverpa, leafhopper, lace bug, ladybird, leafroller, potato moth, pumpkin beetle, Rutherglen bug, tomato grub, grasshopper, caterpillar, fungus, leaf spot, thrips, elf leaf beetle, aphid	20 g/kg	Dust lightly over all surfaces every 7–10 days.
		WP 80–120 g/kg	Either packed in 60 g measure packs to be diluted into 5L water or use 0.8–1 g/L water. Apply at 7–14 day intervals.
		AC/SC 100 g/L	Dilute to 1 g/L. Spray when insects first appear then every 7–10 days.
		AC 400–500 g/L	Use 1 g/L ai. Apply at first signs of pest activity.
		WP 800 g/kg	Spray when insects first appear then every 7–10 days. Elf leaf beetle – apply to trunk of tree in December. Repeat 4–6 weeks later. Apply in 0.5m wide band around trunk.
DOMESTIC USES			
Carpet, garden, general home, general non-crop area, rug, animal bedding	Flea, louse, mite, millipede, grasshopper, cricket, earwig	18–50 g/kg dusts	Dust area where insects seen.
		50 g/kg (animal houses, bedding, carpet)	Apply 2 kg/100sq m dust through muslin bag or by powder or hand dust. Sprinkle on floor. Sprinkle over carpet and leave for at least 1 hour then vacuum. Repeat every 14 days.
		Bait 18 g/kg	Scatter bait in garden or fill tray and place wherever pests are present.
DOMESTIC LAWN AND TURF			
Lawn	Lawn grub, black-headed cockchafer, armyworm, budworm	Ready-to-use liquid 60 g/L	Use with a hose-on applicator. Spray at the first signs of infestation.
Turf	Black-headed cockchafer	AC/SC 100 g/L	Turf: dilute to 2.5 g/L. Spray 8L over 50 sq m.

2.3 Home veterinary uses of carbaryl products in Australia

The majority of veterinary uses for carbaryl are for control of ectoparasites on domestic animals, including birds. The pests controlled include fleas, mites, mange and ticks. The products available for control of these pests are in the form of shampoos and dusting powders. There are also registered carbaryl products used to control earmites and bacterial/fungal ear infections in dogs and cats (see Table 3).

Table 3: Summary of home veterinary uses of carbaryl

Animal	Pest/condition	Product description	Application instructions
Dogs, cats, birds, rabbits, guinea pigs, mice and animal housing	Lice, ticks, mites, black beetles	Dusting powder containing 40 g/kg carbaryl and 10 g/kg of maldison	Apply directly to bird or animal and rub into coat, feathers or fur 50 g squeeze pack: Squeeze container quickly and firmly directing the resulting cloud of powder towards the bird. Liberally dust cage floor and perches
Dogs and cats	Earmites, mild bacterial and fungal ear infections	Ear drop containing 10 mg/mL carbaryl with 20 mg/mL salicylic acid and 2 mg/mL chlorcresol	Apply several drops to both ear canals twice daily for at least 14 days
	Brown dog ticks, mange mites, lice	Shampoo containing 10–40 g/L carbaryl (some products with other active constituents)	Wet coat and lather well with foam. Massage in and after 5 minutes rinse and dry thoroughly
Dogs, cats, rabbits, mice, guinea pigs	Fleas, ticks (except paralysis tick), lice	Grooming powder containing 50 g/kg carbaryl dust (some products with other active constituents)	Shake powder on to animal and work in well. Apply 0.25 g carbaryl brushed into the fur of the animal and excess removed with a damp cloth Brush off excess dust. Repeat each week

2.4 Poultry use of a carbaryl product in Australia

There is one registered product—KEYDUST Dusting Powder—used on poultry in Australia. A summary of the use patterns for KEYDUST Dusting Powder is shown in Table 4.

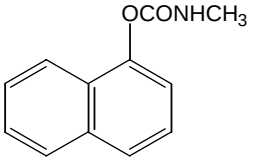
Table 4: Currently registered use patterns for KEYDUST Dusting Powder on poultry and poultry housing

Pest	Product description	Application instructions	Withholding period
Poultry lice (order Mallophaga) Ticks (*Argasidae sp., Dermanyssus sp.*) and mites (*Cnemidocoptes mutans, C. gallinae*).	Dusting powder containing 40 g/kg carbaryl and 10 g/kg maldison	Apply at a rate of 2 kg product/100 m^2 (equivalent to 80 g carbaryl/100 m^2) Dust through muslin bag or by powder or hand duster evenly over litter, nest boxes, under perches or on birds direct	Meat: Nil Eggs: Nil
Black beetle (*Alphitoblus*)		Apply at a rate of 1.7 kg product/100 m^2 (equivalent to 68 g carbaryl/100 m^2). A 25 kg bag of product will cover an average broiler shed of 100 × 15 m Cast the dust against the walls, allowing the excess to fall to the floor. Pay particular attention to the base of the walls and any uprights from the floor	

3. ACTIVE CONSTITUENT ASSESSMENT

The active constituent assessment for the review of carbaryl was undertaken by the APVMA Chemistry and Residues Program. The active constituent assessment is summarised below.

3.1 Chemical identity

Common name:	carbaryl (BSI, E-ISO, ANSI, ESA, BAN, SA)
Synonyms and code number:	Sevin; UC 7744; OMS 629; OMS 29; ENT 23 969
Chemical name:	1-naphthyl methylcarbamate (IUPAC) 1-naphthalenyl methylcarbamate (CAS)
CAS number:	63-25-2
Molecular formula:	$C_{12}H_{11}NO_2$
Molecular weight:	201.2
Chemical structure:	

3.2 Physical and chemical properties of the active constituent

Carbaryl is manufactured to a high purity standard (minimum 980 g/kg).

Physical state:	Solid
Colour:	Colourless to light tan crystals
Odour:	Essentially odourless
Melting point:	142°C
Boiling point:	Decomposes
Solubility in water:	120 mg/L (20°C)
Density/specific gravity:	1.232 (20°C)
Solubility in organic solvents:	dimethylformamide and dimethyl sulfoxide 400–450 g/kg; acetone 200–300 g/kg; cyclohexanone 200–250 g/kg; isopropanol and xylene 100 g/kg (all at 25°C)
Octanol/water partition coefficient:	log P = 1.59
Vapour pressure:	4.1×10^{-2} mPa
Flash point:	193°C
Corrosion characteristics:	Not corrosive
Thermal stability:	Stable to heat up to 70°C
Solution stability:	Stable under neutral and weakly acidic conditions. Hydrolysed in alkaline media to 1-naphthol; DT_{50} 12 days (pH 7), 3.2 hours (pH 9).
Storage stability:	Stable for at least 12 months at ambient temperature
Chemical type:	insecticide
Chemical family:	carbamate

3.3 Composition of carbaryl active constituent

3.3.1 Declaration of composition

The APVMA has previously evaluated declarations of composition (DoC) for all approved sources of carbaryl and found them to be acceptable. In each case the DoC lists the minimum carbaryl content and the maximum content of each relevant impurity present in the active constituent.

3.3.2 Food and Agriculture Organization (FAO) specification

The FAO specification for technical grade carbaryl (FAO Specification 26/TC/S (1989)) is as follows:

Carbaryl	Not less than 980 g/kg
2-Naphthol	Maximum 0.5 g/kg
2-Naphthyl methylcarbamate	Maximum 0.5 g/kg
Loss on vacuum drying	Maximum 10 g/kg

All APVMA-approved sources of carbaryl active constituent comply with the FAO specification.

3.3.3 APVMA minimum compositional standard

The APVMA minimum compositional standard for carbaryl is as follows:

Carbaryl	980 g/kg minimum

All currently approved sources comply with the APVMA minimum compositional standard.

3.4 Manufacture of carbaryl active constituent

All approved sources of carbaryl are manufactured by the same basic process. 1-Naphthol is reacted with methyl isocyanate in the presence of a catalyst. Carbaryl is crystallised from the reaction mixture at a purity of >980 g/kg.

4. SUMMARY OF DATA ASSESSMENTS

4.1 Toxicology

4.1.1 Introduction

The toxicological assessment examined:

- studies intended to elucidate the mechanism of tumour formation
- multi-generation and reproduction and developmental studies in rats and rabbits
- addenda to a previously evaluated developmental neurotoxicity study in rats
- a short-term repeat-dose study and a one-year study in dogs
- exposure studies undertaken on persons using American registered carbaryl products in simulated domestic settings.

The systemic doses likely to be delivered to users of registered carbaryl products under Australian conditions have also been estimated. These estimates have been related to toxicological benchmarks and recommendations made on the continued registration and conditions of use of carbaryl products. The Acceptable Daily Intake (ADI) of 0.008 mg/kg bw/d, was based on vascular tumour formation and the Acute Reference Dose (ARfD) of 0.01 mg/kg bw was based on ChE inhibition, clinical signs, and reduced bw gain. A summary of the toxicological profile of carbaryl is at Appendix B.

4.1.2 Metabolism and toxicokinetics

The absorption, excretion and toxicokinetics of carbaryl are typical of the carbamate class. Carbaryl is extensively absorbed by the oral route and excreted rapidly in the urine by humans and experimental animals except dogs, in which the faeces are also a significant route of excretion. There is little tendency for carbaryl or its metabolites to accumulate in body tissues, even after subchronic administration.

4.1.3 Cholinesterase (ChE) inhibition

Carbaryl possesses anticholinesterase activity typical of members of the carbamate class. In rats, ChE inhibition reaches its maximum between 0.5 and one hour following carbaryl administration by gavage. The subsequent time course of ChE inhibition is both dose- and tissue/site-dependent. Recovery of plasma and red blood cell (RBC) cholinesterase activity is rapid (within two hours post dosing at 10 mg/kg, and within 24 hours at 50 mg/kg). At higher doses reversibility is more prolonged.

4.1.4 Genotoxicity

No new studies were presented for the review. Previous reviews of the genotoxic potential of carbaryl have concluded that carbaryl does not damage DNA and is unlikely to be mutagenic in humans.

4.1.5 Neurotoxicity and behavioural studies

The effects of carbaryl on the nervous system of rats, chickens, monkeys and humans are primarily related to ChE inhibition and are usually transitory. In a developmental neurotoxicity study, carbaryl had no adverse effects on foetal or pup survival, growth or development at up to and including the highest dose of 10 mg/kg bw/d. In both subchronic

and developmental neurotoxicity studies, no adverse findings were made with respect to neuropathology in the adults or offspring.

4.1.6 Reproduction and development

New developmental studies in rats and rabbits were submitted for the review. Maternotoxicity was seen as cholinergic signs in rats, inhibition of plasma and RBC ChE activity in rabbits, and depressed weight gain in both species. Foetal development was retarded at maternally toxic doses, but there were no treatment-related visceral anomalies or malformations.

4.1.7 Carcinogenicity

In chronic rodent studies by Hamada (1993a and 1993b)[3] carbaryl caused tumours of the thyroid, urinary bladder and liver in rats, and kidney, liver and vascular systems in mice. However with the exception of vascular tumours, carcinogenicity did not occur below the highest doses administered (8000 and 7500 ppm in the diet to mice and rats, respectively).

Since carbaryl has not shown any convincing evidence of genotoxic activity, and because no observed effect levels (NOELs) of 1000 and 1500 were demonstrated in the respective species for bladder, hepatic, thyroid and renal tumours, these high dose tumours have not been considered a barrier to continuing registration of carbaryl, subject to adequate safeguards that would limit public exposure to the chemical.

However, the vascular system tumours are of significantly greater concern. Although these did not develop in female mice below the 8000 ppm feeding level, they occurred in males even at the lowest dose of 100 ppm. Despite the fact that carbaryl did not cause cancer to develop in a short-term bioassay in genetically engineered male mice that are highly sensitive to genotoxic carcinogens, there are still limitations in the understanding of carbaryl's carcinogenic properties and its mode or mechanism of action remain uncharacterised. Under the circumstances it is considered that the use of an enhanced safety factor should be maintained and public exposure should be reduced to the lowest extent reasonably achievable. From the data assessed there is no evidence that carbaryl is carcinogenic in humans.

4.1.8 Human studies

The current submission included human exposure studies which measured the amount of carbaryl deposited on the skin and clothing of volunteers using USA carbaryl products under simulated home garden and veterinary conditions. The concentration of carbaryl in the breathing zone air was also measured. The product that had by far the greatest potential for human exposure was a 5 per cent carbaryl veterinary dusting powder. In decreasing order of exposure potential were 10 per cent vegetable dusts, a 22 per cent liquid concentrate applied to vegetables or trees by spray, and a 0.1 per cent ready-to-use vegetable spray. In all cases the majority of exposure occurred via the hands. The veterinary dusting powder also caused significant exposure by inhalation whereas inhalation exposure by vegetable dusting and

[3] Hamada NN (1993a) Combined chronic toxicity and oncogenicity study with carbaryl technical in Sprague-Dawley rats Study No. 656-139 Lab: Hazleton Washington Inc, USA Report date: August 06, 1993 Unpublished [RP, sub 10824]

Hamada NN (1993b) Combined chronic toxicity and oncogenicity study with carbaryl technical in CD-1 mice Study No. 656-138 Lab: Hazleton Washington Inc, USA Report date: May 20, 1993 Unpublished [RP, sub 10824]

application of carbaryl sprays was negligible. In general, only about 5 per cent or less of carbaryl that became deposited on the external clothing penetrated to the skin, and comparison between gloved and un-gloved subjects showed that gloves effected a 95 per cent reduction in exposure.

4.1.9 Exposure from home garden and home veterinary products

The APVMA *Guidelines for Pesticides Used by Householders* stipulate that any domestic pesticide formulation that may be ingested should not be expected to be acutely toxic to a child at doses up to 1500 mg/kg bw and should not be acutely toxic at dermal doses up to 1000 mg/kg bw. The irritancy to skin and eye of domestic pesticide formulations should be low. Several carbaryl products currently sold in home garden pack sizes are unlikely to comply with the above safety threshold. Only products containing 160 g/kg or less of carbaryl would comply with the cut-off value for acute oral toxicity.

The majority of Australian home garden/home veterinary (HG/HV) products were found to be capable of delivering systemic doses to users in excess of the ADI for carbaryl. The only products that were not likely to deliver a toxicologically significant dose of carbaryl were 10g/L pet shampoos, 20 g/kg garden dusts, wettable powder, 1 g/L ready-to-use liquid sprays and HV ear drops.

4.1.10 Conclusions

Recommendations have been formulated with a view to constraining the upper limit of carbaryl intake to the ADI and ARfD, through the use of label hazard warning statements and modifications to protective clothing and equipment. Home garden/veterinary products that have the potential to cause carbaryl intake above the ADI and ARfD under anticipated conditions of use and are not amenable to risk reduction by means of protective clothing/equipment are considered unsuitable for continued registration. Also regarded as unsuitable are products for which there are insufficient data to estimate the extent of household exposure.

The most hazardous products are veterinary dusts. Given that carbaryl shampoos are available and have a lower potential for use exposure than dusts, the most effective course of action would be to remove carbaryl based pet dusts and powders from the home veterinary market.

Although capable of delivering systemic doses two to 12 times higher than the ADI, carbaryl home garden vegetable dusts, wettable powders and liquids would cause much less user exposure than pet dusts. This is primarily because garden use often entails discharge at or below waist height and manual contact with treated vegetation is not required. Inhalation exposure from these products is negligible. Therefore, these products may be used safely provided appropriate warning statements and safety directions appear on the product labels.

Contact with carbaryl applied on turf or around the external areas of the home may result in delivery of a systemic dose above the ADI if the carbaryl was not washed off the contaminated skin within one hour. The appropriate risk reduction strategy here is to recommend that householders keep off treated surfaces.

It is impossible to determine the extent of householder exposure following indoor treatment with carbaryl. Label warnings are considered insufficient to ensure safety. As such it is recommended that carbaryl should not be registered for indoor use.

Insufficient information was provided to ensure that the use of carbaryl products on food producing plants in the home garden would not result in householder exposure exceeding the ARfD for most uses. Some minor uses in the home garden were considered acceptable. Concerns have been raised that if any uses for food-producing plants remain on the labels householders will continue to use products where uses have been identified as not acceptable and removed from labels. As such it is recommended that carbaryl should not be registered for use on food-producing plants in the home garden.

4.2 Residues

4.2.1 Introduction

In evaluating the human dietary exposure to carbaryl residues it was necessary to examine the intake from consumption of food commodities other than grains and animal commodities, in particular fruits and vegetables. To do this, national estimated daily intake (NEDI) and national estimated short-term intake (NESTI) calculations were undertaken. As a result, the residues assessment has enabled recommendations to be developed for amended MRLs to cover all food crop uses of carbaryl.

4.2.2 Direct veterinary application of carbaryl to poultry

One product, KEYDUST Dusting Powder (46851), is registered for control of ectoparasites on poultry (Table 4).

The maximum application rate is 30 kg product/1500 m^2 (average broiler shed), which is equivalent to 1200 g carbaryl/1500 m^2. Assuming that the average broiler shed contains 30 000 birds, this equates to an average exposure rate of 40 mg carbaryl/bird. A bird weighing 2 kg is estimated to consume 150 g dry matter per day. Thus, an exposure rate of 40 mg carbaryl/bird/day is estimated to be equivalent to a feeding level of 265 ppm (dry weight basis). Forty mg carbaryl/bird is also estimated to be equivalent to a direct application rate of 1 g of dust (product)/bird.

4.2.2.1 Residues data considered

The residues aspects of carbaryl have been reviewed by the Joint FAO/WHO Meeting on Pesticide Residues (JMPR) on numerous occasions. The relevant residues data for carbaryl in poultry are reproduced below.

JMPR (1973): Following administration of l-naphthyl-^{14}C-carbaryl to hens, total ^{14}C-residues reached a maximum and dissipated at a much faster rate in egg white than in egg yolk. In a single dose of 10 mg/kg (Paulson and Foil, 1969)[4], maximum concentration of ^{14}C-residues in egg white was 0.12 ppm at one day and dropped to trace amounts on the second day after treatment. The yolk residues reached a maximum at the fifth day (0.36 ppm) and had dissipated by the ninth (0.03 ppm). Under continuous feeding conditions, the total residue in the yolk or white at each sampling time was dosage related (Andrawes *et al*., 1972[5]). Concentration of ^{14}C-carbaryl equivalents (ppm) reached a maximum (0.10 ppm from 70 ppm in feed; 0.025 ppm from 21 ppm in feed) in the white after two to six days and in the yolk (1.0

[4] Paulson, G.D. and Feil, V.J. (1969) *Poultry Sci*. 48: 1593

[5] Andrawes, N.R., Chancey, E.L., Crabtree, R.J. Herrett, R.A. and Weiden, M.H.J. (1972). 'Fate of Napthyl-1-^{14}C-Carbaryl in Laying Chickens'. *Journal of Agricultural Food Chemistry*, 20, 608–617.

ppm from 70 ppm in feed; 0.30 ppm from 21 ppm in feed) after six to nine days of dosing and remained level until the end of the treatment period. At plateau levels, the level of ^{14}C-carbaryl equivalents in the white was one-tenth that in the yolk; however, the total equivalents were in a ratio of 5:1 between yolk and white. The ratio of the concentration of carbaryl in whole eggs (white and yolk) to that in the diet was 0.006 at equilibration. After discontinuation of dosing, residues in the whites had a half-life of less than one day; for yolk residues the half-life was approximately two to three days.

The distribution of carbaryl residues was determined in hen tissues after continuous treatment with either 7, 21 or 70 ppm of l-naphthyl-^{14}C-carbaryl in the diet (Andrawes *et al*., 1972)[6]. Tissue residues were directly proportional to the concentration of carbaryl in the diet. The highest residues were found in the blood and tissues of high blood content (liver, kidney, lung and spleen); body fat, brain and muscles contained the lowest residues. For example, the distribution of ^{14}C-carbaryl equivalents one day after treatment for 14 days with 70 ppm in the diet was as follows (in ppm): liver 0.41, kidney 0.485, thigh 0.03, leg 0.032, breast 0.031, skin 0.043, fat 0.026, gizzard 0.04, heart 0.049, and brain 0.017. The half-life of total body residues was calculated to be five days.

JMPR (1976): In continuous feeding studies with radio-labelled carbaryl (Andrawes *et al*., 1972), residues reached maximum levels within one day in the excrement, two days in egg white and six to eight days in egg yolk. The residues in the whole egg (yolk plus white) were directly proportional to the amount of carbaryl fed. An intake of 7 mg/kg of carbaryl in the feed resulted in a residue of 0.04 mg/kg carbaryl equivalents in the whole egg. Radio-labelled residues in the excrement 15 hours after the initial treatment reached 80–100 per cent of the dose. Within one day after the discontinuation of dosing, the highest tissue residues were found in the excretory organs while very low residues were found in the fat indicating that carbaryl residues are not stored in body tissues. This work shows that carbaryl is metabolised in laying hens by pathways similar to those in mammals.

JMPR (1984): Following the request of the Codex Committee on Pesticide Residues (CCPR), information concerning the use of carbaryl on or near poultry was received by FAO from several countries.

- In Canada, carbaryl is the major pesticide used for direct application to poultry for control of mites. It is also approved for direct application to poultry against lice and as a supplement to premise treatment for chicken mites, fleas and fowl ticks. Carbaryl spray and dust is applied directly to poultry at the rate of 22.5 g/100 birds. Carbaryl dust (5 per cent) is applied to poultry dusting boxes at the rate of 120 g ai/100 birds. The treatment is not to be made within seven days of slaughter (Canada, 1984[7]).
- In the Netherlands, carbaryl is approved for the treatment of pens, sheds and other structures for the control of chicken mites, lice, mealworms and fleas. A suspension containing 5 g/L is used at the rate of 1 L/35 sq m. Carbaryl dust was authorised for direct application to poultry but was withdrawn in 1980 because of unpredictable residues in meat and eggs (Netherlands, 1984[8]).

[6] Andrawes, N.R., Chancey, E.L., Crabtree, R.J. Herrett, R.A. and Weiden, M.H.J. (1972). 'Fate of Napthyl-1-^{14}C-Carbaryl in Laying Chickens'. *Journal of Agricultural Food Chemistry*, 20, 608–617.

[7] Canada (1984). Information on use patterns of carbaryl in poultry submitted 1984 by Canada to FAO.

[8] Netherlands (1984). Information on use patterns of carbaryl in poultry 1984 submitted by the Netherlands to FAO.

- In Portugal, carbaryl is approved for direct application to poultry as a 5 per cent dust, with or without pyrethrum. An interval of two weeks between treatments is recommended, with an interval of seven days between the last application and slaughter (Portugal, 1984[9]).
- In the United States, carbaryl suspension concentrates, wettable powders and dusts may be applied directly to poultry for the control of northern fowl mite, chicken mite, lice and fleas. The dust is applied at the rate of 500 g/100 birds and 0.5 per cent sprays at the rate of 4 L/100 birds. Carbaryl dust (5 per cent) is used in dust baths at the rate of 1 kg per box for each 50 birds. There is a seven-day interval between the last application and day of slaughter. The relative proportion of dust and spray is not known (United States, 1984[10]).

The following summary of results from three residue trials on laying hens and poultry poults indicates the level and distribution of carbaryl residues in poultry tissues (Union Carbide, 1984[11]).

In the first trial, laying hens were dusted with 4 g of 5 per cent dust per bird (recommended rate) three times at four day intervals (once in 28 days is recommended) and slaughtered at one and seven days after the last treatment. Samples of skin, breast muscle, leg muscle and liver were taken from each of six hens and separately analysed following each slaughter. The colorimetric method of Johnson *et al*. (1963)[12] was used to determine carbaryl and 1-naphthol separately at a method sensitivity of 0.1 to 0.2 mg/kg. Residues of 1-naphthol were less than 10 per cent of carbaryl residues in every case. Results below (Table 5) are averages of duplicate analyses on each bird.

Table 5: Averages of duplicate results of carbaryl residues in laying hens

Tissue	Residues at 1 day post-treatment (mg/kg)		Residues at 7 days post-treatment (mg/kg)	
	Maximum	Average	Maximum	Average
Chicken skin	35.0	19.3	3.1	2.2
Breast muscle	1.1	0.4	0.1	<0.2
Leg muscle	2.0	0.9	0.1	0.1
Liver	0.2	<0.2	<0.2	<0.2

In the second trial, turkey poults at two weeks of age were dusted with 5 per cent carbaryl three times at 14-day intervals, using a squeeze bottle applying 1, 2 and 3 g/bird, successively. Sprays of 0.5 per cent were applied at the same time using 1 and 1.5 mL/bird. Sampling and analyses were performed as per the first trial. Results below (Table 6) are averages of duplicate analyses on each bird.

[9] Portugal (1984) Information on use patterns of carbaryl in poultry submitted 1984 by Portugal to FAO.
[10] United States (1984). Information on use patterns of carbaryl in poultry 1984 submitted by the United States to FAO.
[11] Union Carbide (1984). Information on residues of carbaryl in poultry 1984 submitted by Union Carbide Agricultural Products Company to FAO.
[12] Johnson, D.P., Critchfield, F.E. & Arthur, B.W. (1963). Determination of Sevin insecticide and its metabolites in poultry tissues and eggs. *J. Agric. Food Chem*., 11:77-80.

Table 6: Averages of duplicate results of carbaryl residues in turkey poults

Tissue	Carbaryl residues (mg/kg)	
	1 day post-treatment	7 days post-treatment
Dusted		
Skin	0.99	1.06
Breast	0.64	2.07
Liver	1.89	1.64
Sprayed		
Skin	1.59	0.96
Breast	0.09	1.18

In the third trial, mature hens were treated using dust/bath boxes employing 5 per cent carbaryl dust. Sampling and analyses were performed as per the first trial. Results below (Table 7) are averages of duplicate analyses on each bird.

Table 7: Averages of duplicate results of carbaryl residues in mature hens

Tissue	Average carbaryl residues (mg/kg)		
	7 days post-treatment	14 days post-treatment	28 days post-treatment
Breast	<0.2	<0.2	<0.2
Skin	0.96	0.37	0.08
Liver	<0.2	<0.2	<0.2

JMPR (2002): The metabolism of carbaryl in hens was studied after oral administration of 1-naphthyl-^{14}C carbaryl to laying hens treated twice a day for seven consecutive days at 8.8 ppm and 10.5 ppm of carbaryl in the diet. On average, 97.7 per cent of the radioactivity was recovered in the excreta. Tissues contained only 0.17 per cent of the administered dose, mostly concentrated in kidney (0.268 mg equiv./kg) and liver (0.187 mg equiv./kg). Egg yolk contained up to 0.176 mg equiv./kg, with 1-naphthol sulphate being the major metabolite (0.078 mg equiv./kg). Desmethylcarbaryl was the major metabolite in liver (0.017 mg equiv./kg), and 1-naphthol was the major metabolite in abdominal fat (39.1 mg equiv./kg). The highest concentration of free carbaryl was found in fat (26.9 per cent of total radioactive residues (TRR), 0.004 mg equiv./kg).

For poultry, the maximum and supervised trial median residue (STMR) estimated dietary burden were 34.4 and 6.4 mg/kg feed, respectively. Metabolism studies on hens conducted at 8.8 and 10.5 mg/kg feed (seven consecutive days orally dosed) showed detectable residue of carbaryl in egg yolks, liver and abdominal fat (0.001 to 0.004 mg/kg ^{14}C-carbaryl equivalents). The JMPR agreed that this study is not adequate to estimate maximum residue levels of carbaryl in poultry.

4.2.2.2 Residues discussion

Carbaryl residues in tissues from treated birds

It is noted that the registered (overseas) use patterns of carbaryl dust on poultry (as reported by JMPR, 1984) appear to be significantly higher than the corresponding Australian use patterns: the overseas dose rates range from 150 to 250 mg carbaryl/bird, and incorporate a seven-day withholding period (WHP). In contrast, the estimated Australian exposure rate is ~40 mg carbaryl/bird with nil meat and egg WHPs.

When laying hens were dusted with three applications of 200 mg carbaryl/bird at four-day intervals, maximum residues in edible chicken tissues at one day after the last treatment were 35 mg/kg for skin, 2.0 mg/kg for muscle and 0.2 mg/kg for liver. Assuming a linear correlation between dose rate and residue concentration, correction to the 1× dose rate of 40 mg carbaryl/bird gives residues of 7 mg/kg for skin, 0.4 mg/kg for muscle and 0.04 mg/kg for liver.

In a second study where turkey poults were dusted three times at 14-day intervals with 50, 100 and 150 mg carbaryl/bird (successive applications), average carbaryl residues at one day after the last treatment were 0.99 mg/kg for skin, 0.64 mg/kg for breast muscle, and 1.89 mg/kg for liver. Correction of these results to the 1× rate of 40 mg carbaryl/bird gives residues of 0.26 mg/kg for skin, 0.17 mg/kg for muscle and 0.50 mg/kg for liver. It is also noted that the levels of carbaryl residues in skin and breast muscle were higher at seven days post-treatment than at one day post-treatment.

Based on the available residues data, it is clear that direct (veterinary) application of carbaryl-based dust products on poultry is likely to result in residue levels that exceed the poultry MRLs, 0.2 mg/kg for poultry offal and *0.02 mg/kg for poultry meat.

Carbaryl residues in eggs from treated birds

The amount of residues data for eggs from hens that were treated directly with carbaryl (via dusting) is very limited. In one study conducted by Schenck *et al*. (2003)[13], hens were dusted once with 10 per cent carbaryl powder (application rate not provided). Eggs from treated birds contained 0.076 mg/kg at one day post-treatment, and residues declined to 0.054 mg/kg at two days post-treatment, and 0.042 mg/kg at six days post-treatment. These results indicate that the direct application of carbaryl-based dust products on laying hens is likely to result in residue levels that exceed the egg MRL of *0.02[14] mg/kg.

4.2.2.3 Conclusion

Based on the available residues data, it is concluded that the use of carbaryl on poultry, as per the directions on the product label for KEYDUST Dusting Powder (P46851), is likely to result in residues in edible poultry commodities that exceed the MRLs (ie 0.2 mg/kg for poultry offal, *0.02 mg/kg for poultry meat, and *0.02 mg/kg for eggs).

The available data are not considered adequate to enable revision of the MRL recommendations (to cover the direct dust application to poultry), since none of the trials addressed the maximum Australian use rate. Furthermore, studies show that levels of carbaryl residues in skin and breast muscle were higher at seven days post-treatment than at one day post-treatment. The Australian use pattern is associated with nil meat and egg WHPs, which means that the MRLs need to cover residue levels at all times post-treatment.

[13] Schenck, F.J., Donoghue, D.J., Hobbs, J.E.,ORA, FDA, Atlanta GA and University of Arkansas Fayetteville AR (2003). Determination of N-Methyl Carbamate Pesticide Residue in Eggs at PPB Levels using a Solid Phase Extraction Cleanup. 2003 FDA Science Forum Poster Abstract: 299.

[14] (*) denotes that the maximum residue limit (MRL) has been set "at or about" the limit of analytical quantitation.

4.2.3 Dietary intake

The toxicology review recommended an increase in the ADI from 0.004 mg/kg bw/day to 0.008 mg/kg bw/day. In addition an ARfD of 0.01 mg/kg bw/day was established for carbaryl. It is therefore necessary to determine that the current use patterns will not result in a dietary intake that will exceed the revised ADI for lifetime exposure (chronic dietary intake), or the ARfD for short-term exposure (acute dietary intake).

Carbaryl has not been included in any of the Food Standards Australia New Zealand (FSANZ) market basket surveys or total diet surveys of the last decade and so there is no information on actual dietary exposure. In such cases conservative models that overestimate dietary intake are used to establish human safety. The model used in Australia and recommended by the joint consultation of the WHO and FAO on dietary exposure to pesticides is the NEDI and NESTI calculations.

In the NEDI calculation use is made of survey results for agricultural commodities, processing factors for commodities such as washing, peeling or cooking, and median or maximum residues for 'worst-case' trials. If there are no data to allow any reduction in the residue level it is assumed that residues are present at levels corresponding to the MRL (worst-case).

The NEDI calculation using the recommended MRLs together with those already established accounts for approximately 89 per cent of the ADI of 0.004 mg/kg bw/day. As the NEDI calculation is widely recognised as a gross overestimate of the likely intake and the estimated exposure is less than the ADI it is concluded that the risk to human health from exposure to carbaryl residues in the diet is minimal.

Where insufficient residue trial data were available, the highest residue (HR) from trials of a similar crop or the current MRL was used as the HR value in the NESTI calculations. A minimum of 41 consumers is required in the dietary survey results to adequately determine the 97.5th percentile consumption figure. Where the number of consumers was less than 41, large portion sizes of similar commodities were used. Where the number of consumers was still less than 41, the consumption figure for the entire crop group was used as a conservative estimate.

Of the crops and commodities for which there were sufficient residues data available to allow the establishment of an MRL, the NESTI calculation did not exceed the ARfD for the following:

- raspberries
- beetroot, potato, sugarbeet, turnips (Swede)
- pome fruit (fruit thinning use pattern only)
- macadamia nuts, pecan nuts
- cottonseed
- cereal grains
- animal commodities.

4.2.4 Changes to MRL standard

Sufficient data were available to allow revision of the current MRLs for a number of commodities.

4.3 International regulatory status

4.3.1 JMPR activity

Carbaryl was reviewed by the JMPR in 1963, 1965, 1966, 1967, 1969 and 1973. The original ADI of 0–0.02 mg/kg bw/d was set in 1963 on the basis of a no observed adverse effect limit (NOAEL) of 1.8 mg/kg bw/d in a one-year dog study. This was revised to 0–0.01 mg/kg bw/d in 1969 because of concern about effects on the male reproductive system seen in a one-year gavage study in rats with a NOAEL of 2 mg/kg bw/d, and because a dose of 0.12 mg/kg bw/d may have affected renal function in a six-week study in humans. In 1973, the JMPR established a full ADI of 0–0.01 mg/kg bw/d.

The JMPR carried out a further toxicological review of carbaryl in 1996, and decreased the ADI to 0.003 mg/kg bw/d by application of a 5000-fold safety factor to the lowest observable effect limit (LOEL) for vascular tumours in male mice. The JMPR again considered carbaryl in 2001. The ADI was revised upwards to 0.008 mg/kg bw/d; while the basis for the ADI was unchanged, the safety factor was relaxed to 2000. The JMPR also established an ARfD for carbaryl of 0.2 mg/kg bw, based on an NOAEL for ChE inhibition of 125 ppm (equal to 3.8 mg/kg bw/d) in a five-week dietary study in dogs. A safety factor of 25 was applied because ChE inhibition by carbaryl (in rats) is 'rapidly reversible and driven by the peak concentration in plasma'.

4.3.2 United States Environmental Protection Agency (USEPA) activity

In October 1996, the USEPA imposed exposure mitigation measures on carbaryl based products. Pending the submission of user exposure studies to the agency, approval was suspended for using dust formulations on trees and ornamental plants where application was intended to be higher than chest height, and some applications to pets. The conditions of use of household liquid and dust products were amended to prohibit use more than once per week, and to mandate that gloves be worn during application.

In June 2003 the USEPA released an Interim Re-registration Eligibility Decision (IRED) for carbaryl. The report stated that 'although all uses of carbaryl may not meet current safety standards and some uses may pose unreasonable risks to human health and the environment these effects could be mitigated'.

Outcomes
The report supported the continued registration of carbaryl products.

Dietary risk
Both the acute and chronic risks of exposure to carbaryl from food were found to be below the USEPA's level of concern.

The USEPA ADI is 0.008 mg/kg bw/d, in accordance with the JMPR level outlined in Section 4.3.1 above. (As is recommended in this Review Findings report, the ADI for Australia as set by OCS has been revised from 0.004 mg/kg bw/d to 0.008 mg/kg bw/d in accordance with the relaxing of the safety factor to 2000.)

The USEPA acute and chronic reference doses are both 0.01 mg/kg/d. The ARfD was based on a NOAEL of 1 mg/kg/d in a rat developmental neurotoxicity study, to which an

uncertainty factor of 100 was applied. The chronic RfD was derived by applying a 300-fold uncertainty factor to a LOAEL of 3.1 mg/kg/d for inhibition of plasma and brain ChE activity in a chronic dog study.

Residential risk
The USEPA was concerned about the exposure of householders using carbaryl lawn, garden, ornamental plant and pet flea control products as well as adults doing garden work and toddlers playing on treated lawns. As an outcome of these concerns the registrant cancelled all liquid and dust uses on pets, except flea collars. Other risks were mitigated by changes to the amount of active ingredient, packaging and size of residential products and the cancelling of liquid board casts on lawns (pending the results of data being developed).

4.3.3 *United Kingdom Department of Environment, Food and Rural Affairs report Sept 1996 (formerly Ministry for Agriculture, Fisheries and Forestry (UK MAFF))*

An initial review conducted in 1996 by the UK identified toxicological concerns about worker exposure to carbaryl. At this time the regulatory actions taken included:

- revocation of use in poultry houses
- prohibition of application via hand-held or similar equipment
- revocation of home garden uses of carbaryl
- modification to application equipment
- strengthening of label protective equipment requirements.

In 1998 the UK commenced a review of anticholinesterase compounds that included examination of carbaryl. Registrants were not prepared to support the continued registration of carbaryl through such a review and therefore all carbaryl products were phased out.

4.4 Protected Data

At the commencement of the review and after the extensions of the scope of the review, registrants were required under s32 of the Agvet Code to provide data and information to the APVMA that is relevant to the reconsideration. The Agvet Codes provide that a person who authorised the used of protected information by the APVMA in conducting the review of the continued approvals, or registration a product of another party, may be eligible to receive compensation from that other party. Protected information remains protected for a period of time determined by the regulations to the Agvet Codes. The APVMA must not use protected information to support the approval (or the continued approval) of another, active constituent for a proposed or existing chemical product or registration (or the continued registration) of another chemical product, unless the two parties have agreed as to the terms of compensation to be paid by the registrant of that other chemical product to the owner of the protected information. Data that was relied on for the reconsideration and for which a protection period remains is listed in Table 8.

Table 8: Protected data that was relied on for the reconsideration.

Data Number	Author (s)	Title	Date	Data Protected Until	Authorising Party
DPS 5576	Debruyne, E.	Carbaryl 52-Week Toxicity Study In The Cd1 Mouse Target Organs Cell Cycling Assessment	1998	12 November 2006	Bayer CropScience Pty Ltd
DPS 5577	Irisarris, E.	Carbaryl 52-Week Toxicity Study In the Rat And Mouse Target Organs Cell Cycling Assessment Pathology Report (Post-Mortem)	1996	12 November 2006	Bayer CropScience Pty Ltd
DPS 5622	Hamada, N.	One-Year Oral Toxicity Study In Beagle Dogs With Carbaryl Technical	1997	10 December 2007	Bayer CropScience Pty Ltd
DPS 7726	Austin, E.W.	E.W.4-Week Repeated-Dose Dermal Toxicity Study With Carbaryl Technical In Rats	2002	21 May 2006	Bayer CropScience Pty Ltd
DPS 7727	Austin, E.W.	4-Week Repeated-Dose Dermal Toxicity Study With Sevin Xlr Plus In Rats	2002	21 May 2006	Bayer CropScience Pty Ltd
DPS 7728	Austin, E.W.	4 Week Repeated-Dose Dermal Toxicity Study With Sevin 80s In Rats	2002	21 May 2006	Bayer CropScience Pty Ltd
DPS 7729	Mester, T.C.	Carbaryl: Determination Of Transferable Residues From Turf Treated With Dragon Sevin Liquid	1999	21 May 2006	Bayer CropScience Pty Ltd
DPS 7730	Rice, F. and Grant, J.	Measurement Of Pesticide Exposure Of Suburban Residents Associated With The Residential Use Of Carbaryl	2003	21 May 2007	Bayer CropScience Pty Ltd

5. PROPOSED REGULATORY DECISION

On the basis of the evaluation of the submitted data and information (including protected information), the following regulatory action is proposed with regard to the continued registrations and approvals of carbaryl products for home garden, home veterinary, poultry and domestic use in Australia. Registrants may be required to pay compensation to providers of data. Registrants will be contacted separately.

5.1 Label variations

5.1.1 Label variations that do not include changes in use patterns

The APVMA is NOT SATISFIED that labels for products in Table 9 contain adequate instructions in relation to the criteria set out in section 14(3)(g) of the Agvet Codes as well as those referred to in Regulations 11 and 12 of the Agvet Code Regulations. However the APVMA IS SATISFIED that the conditions of label approval can be VARIED, in accordance with section 34(5) of the Agvet Codes.

Once the label variations have been made the APVMA can be SATISFIED that labels contain adequate instructions. On this basis the APVMA can also be SATISFIED that continued registration of the products in accordance with their instructions for use:

- would not be an undue hazard to the safety of people exposed to them during its handling or people using anything containing its residues; and
- would not be likely to have an effect that is harmful to human beings.

On this basis the registration of products in Table 9 can be AFFIRMED.

Table 9: Product registration to be affirmed with label variations

Product number	Product name	Registrant	Label approval number
33575	Fido's Fre-Itch Flea Shampoo For Cats And Dogs	Mavlab Pty Ltd	33575/1002
39998	Fido's Ear Drops	Mavlab Pty Ltd	39998/0101
47966	I Love My Pet Ear Drops Ear Cleaner & Treatment For Cats And Dogs	My Pet Products Australia Pty Ltd	47966/01
50741	I Love My Pet Flea Rid Shampoo For Dogs & Cats	My Pet Products Australia Pty Ltd	50741/0598

5.1.2 Label variations that include deletion of use patterns

As an outcome of the review, changes to approved labels have been recommended. These changes are detailed in Sections 5.1.2.1 and 5.1.2.2 below.

5.1.2.1 Deletion of use patterns

- Delete home garden use on all food-producing plants.
- Delete use on poultry.
- Delete use of veterinary dusts.
- Delete use of dust formulations for indoor use on domestic premises.
- Delete use of dust formulations for treatment of carpets, rugs and animal bedding.

5.1.2.2 Additional label statements

A maximum carbaryl concentration of 160 g/kg (or g/L) is recommended for home garden products, as more concentrated preparations are expected to have acute oral LD_{50} above 1500 mg/kg bw and therefore exceed the safety threshold for registration of home garden products. Products affected by the discussed changes are listed in Table 10.

It is recommended that the labels of home garden products be varied to ensure uses of the product comply with registration restrictions on carbaryl products. The following label statement is to be added to all home garden products.

Insert: **DO NOT** Apply To Food Producing Plants.

The following warning statement is to be added to products applied on and around the exterior of domestic premises**:**

Insert: Avoid Bare Skin Contact With Treated Surfaces for 7 days.

5.1.2.3 Summary

Table 10 below lists the above label changes by situation and pest.

Table 10: Summary of label changes by situation and pest

Situation	Pest	Recommendation
Home veterinary dusts for the treatment of animals and birds	Fleas, mites, ticks, lice	User exposure is likely to exceed the ADI and recommended ARfD. **Delete from labels**
Dust formulations for treatment of carpets, rugs and animal bedding	Fleas, mites, ticks, lice	Insufficient data were received to enable the assessment to estimate householder exposure and ensure an adequate margin of safety. **Delete from labels**
Poultry	Mites, ticks, lice	Insufficient data were available to assess residues in poultry from direct animal treatment. **Delete from labels**
Food-producing plants	Various insect pests	Insufficient data were available to establish an MRL. **Delete from labels**
Ornamentals, lawns, elm trees (in non-crop areas), kenaf, duboisia and rosella	Variety of leaf eating insects	No concerns associated with use. **Retain use**

5.1.2.4 Proposed label variations

The APVMA is NOT SATISFIED that labels for products in Table 11 contain adequate instructions in relation to the criteria set out in section 14(3)(g) of the Agvet Codes as well as those referred to in Regulations 11 and 12 of the Agvet Code Regulations. Product labels also contain use patterns recommended to be deleted. However the APVMA IS SATISFIED that the conditions of label approval can be VARIED, in accordance with section 34(5) of the Agvet Codes.

Once the label variations have been made the APVMA can be SATISFIED that labels contain adequate instructions. On this basis the APVMA can be SATISFIED that continued registration of the products in accordance with its instructions for use:

- would not be an undue hazard to the safety of people exposed to it during its handling or people using anything containing its residues; and
- would not be likely to have an effect that is harmful to human beings.

On this basis the registration of products in Table 11 can be AFFIRMED.

Table 11: The following registered products and label approval numbers are affected by the proposed label variations describe in Section 5.1.

Product number	Product name	Registrant	Label approval number
31995	CRG Liquid Carbaryl Insect Spray	Chemical Recovery Co Pty Ltd	31995/0798
32002	Yates Carbaryl Caterpillar & Grasshopper Insect Spray	Arthur Yates & Co Limited	32002/0202
39082	Hortico Hose-On Lawn Grub Killer	Orica Australia Pty Ltd	39082/0700
39876	Yates Garden Spray Insecticide Fungicide	Arthur Yates & Co Limited	39876/0998
42261	David Grays Cricket & Grasshopper Killer Bait	David Gray & Co. Pty Limited	42261/1202
45944	Garden King Multipest SCC General Purpose Insecticide-Fungicide-Miticide	Envirogreen Pty Ltd	45944/0503^
52493	Richgro Garden Products Carbaryl Caterpillar & Grasshopper Insecticide	A Richards Pty Ltd T/A Richgro Garden Products	52493/0300
54634	Richgro Garden Products Armyworms, Cockchafers & Lawn Grub Killer	A Richards Pty Ltd T/A Richgro Garden Products	54634/0603^

^ Labels approved after the commencement of the extended scope of the review, that are subject to the outcomes of the review.

5.2 Cancellations of registrations and label approvals

The APVMA is NOT SATISFIED that the labels for products in Table 12 contain adequate instructions in relation to the criteria set out in section 14 (3)(g) of the Agvet Codes as well as those referred to in Regulations 11 and 12 of the Agvet Code Regulations. Product labels also contain use patterns recommended to be deleted.

The APVMA is NOT SATISFIED that the conditions of registration of these products can be varied in such a way that the requirements for continued registration will be complied with. On this basis the APVMA is NOT SATISFIED that continued registration of the products in accordance with their instructions for use:

- would not be an undue hazard to the safety of people exposed to them during their handling or people using anything containing their residues; and
- would not be likely to have an effect that is harmful to human beings.

On this basis the registrations of products in Table 12 are to be CANCELLED.

Table 12: Products proposed to be cancelled

Product number	Product name	Registrant	Label approval numbers
Reason: Continued registration would be likely to have an effect that is harmful to human beings. The concentration of carbaryl in these products exceeds the safety threshold for registration of home garden products (>160g/kg or 160 g/L).			
31997	Chemspray Carbaryl Insecticide	Envirogreen Pty Ltd	31997/0802 31997/0903^
49325	Kendon Carbaryl Liquid Insecticide	Kendon Chemicals & Mnfg Co Pty Ltd	49325/1098 49325/0400
49326	Kendon Carbaryl Wettable Powder Insecticide (HG labels and pack sizes only)	Kendon Chemicals & Mnfg Co Pty Ltd	49326/0400
49937	Garden King Carbaryl Liquid Insecticide	Envirogreen Pty Ltd	49937/0802 49937/1097
54949	David Grays Carbaryl Liquid Insecticide	David Gray & Co. Pty Limited	54949/0102

Product number	Product name	Registrant	Label approval numbers
Reason: Insufficient data exist to allow an evaluation of the potential hazard to human beings from the use of this product.			
50102	Friskies Kill Flea Carpet Deodoriser	Go-Pet Petcare Solutions, a division of Nestle Australia Ltd	50102/0798
Reason: There is an unacceptable risk of user exposure from home veterinary dusts for the treatment of animals and birds that is likely to exceed the ADI and recommended ARfD and revised warning statements and enhanced personal protective equipment are not likely to be effective in protecting users from absorbing toxicologically significant systemic doses of carbaryl.			
33576	Saint Bernard Flea Powder For Dogs And Cats	Saint Bernard Pet Care Pty Ltd	33576/01 33576/0402 33576/0801
36387	Watch Cat Flea Powder For Cats	Go-Pet Petcare Solutions a division of Nestle Australia Ltd	36387/0299 36387/1198
36388	Watch Dog Flea Powder For Dogs	Go-Pet Petcare Solutions a division of Nestle Australia Ltd	36388/0299 36388/1198
37434	Fido's Free-Itch CPP Flea Powder For Cats And Dogs	Mavlab Pty Ltd	37434/0101
40080	Fido's Fre Itch Flea Powder	Mavlab Pty Ltd	40080/0402
41244	David Skatta-7 Tick Flea Louse Powder	Bocko P/L & Trademarketing Solutions P/L T/A Pharmachem	41244/0901
46851	Keydust Dusting Powder	International Animal Health Products Pty Ltd	46851/0100
51206	Family Pets Flea And Tick Pet Grooming Powder For Dogs, Cats Puppies And Kittens	Aristopet Pty Ltd T/A Family Companion Pet Products	51206/0998
Reason: Dietary intake exceeds the acute reference dose.			
39864	Yates Lanosan Tomato Spray Insecticides And Fungicide	Arthur Yates & Co Limited	39864/0500 39864/0598
42054	David Grays Tomato Dust	David Gray & Co. Pty Limited	42054/02
42055	David Grays Vegetable Dust	David Gray & Co. Pty Limited	42055/02
48753	Tomato Dust Insecticides And Fungicide	Crop Care Australasia Pty Ltd	48753/01
53260	Hortico Tomato Dust	Orica Australia Pty Ltd	53260/0700
53912	Yates Ready To Use Tomato Gun Pest & Disease Spray	Arthur Yates & Co Limited	53912/0702
Reason: Insufficient data are available to ensure dietary intake would not exceed the acute reference dose.			
53231	Hortico Cabbage Dust	Orica Australia Pty Ltd	53234/0700
Reason: Dietary intake exceeds the acute reference dose for some uses and the product name is compatible with remaining label uses.			
52472	Garden King Tomato & Vegetable Dust Insecticide & Fungicide	Envirogreen Pty Ltd	52475/0702

^ Labels approved after the commencement of the extended scope of the review, that are subject to the outcomes of the review.

5.3 Products registered after the extended scope of the review to be cancelled as an outcome of review findings

As an outcome of the review findings, the APVMA, having regard to the matters referred to in subsection 14 (5) of the Agvet Codes, makes the following recommendation for the continued use of or any other dealing with four products (Table 13) containing carbaryl for use in the home garden and domestic situations. The APVMA is NOT SATISFIED that the products in Table 13 would not be an undue hazard to the safety of people exposed to them during their handling or people using anything containing their residues and would not be likely to have an effect that is harmful to human beings. Therefore, on this basis the registrations and approvals for these products are to be cancelled under section 41 of the Agvet Codes.

Table 13: Products registered after the commencement of the extended scope of the review to be cancelled as an outcome of the review

Product number	Product name	Registrant	Type of product	Label approval number
57952	Go-Pet Kill Flea Carpet Deodoriser	Go-Pet Petcare Solutions a division of Nestle Australia Ltd	Domestic	57952/0903
58127	Yates Insect & Disease Control Blitzem Tomato Gun	Orica Australia Pty Ltd	Home garden	58127/0903
58135	Yates Insect & Disease Control Blitzem Tomato Dust	Orica Australia Pty Ltd	Home garden	58135/0903
59431	Yates Insect & Disease Control Blitzem Lanosan Tomato Spray	Orica Australia Pty Ltd	Home garden	59431/0105

5.4 Withdrawn carbaryl products

A number of carbaryl products (Table 14) have been voluntarily withdrawn since the commencement of the review (once cancellation of registration is formally effected, reconsideration is no longer required).

Table 14: Carbaryl products included in the review that have been withdrawn prior to the completion of the review

Product number	Product name	Registrant	Label approval number
32000	Defender Home Garden Grasshopper Caterpillar Carbaryl Insecticide	Scotts Australia Pty Ltd	Ψ
33194	Hortico Carbaryl Cabbage Dust	Orica Australia Pty Ltd	Ψ
33957	Hortico Carbaryl Tomato Dust	Orica Australia Pty Ltd	Ψ
39879	Yates Carbaryl Cabbage Dust	Arthur Yates & Co Limited	39879/0802
40754	Defender Home Garden European Wasp and Insect Dust	Scotts Australia Pty Ltd	Ψ
41250	Vetapet Coalfoam Medicated Foam With Ectoparasitic Control For Dogs And Cats	Bocko P/L & Trademarketing Solutions P/L T/A Pharmachem	41250/1101
42029	David Grays Flower Dust	David Gray & Co. Pty Limited	42029/0702
42041	David Grays Rose Dust	David Gray & Co. Pty Limited	42041/02
46303	Masterpet Flea Powder For All Dogs And Cats 100gm	Masterpet Australia Pty Limited	46303/001
47108	Chemspray Carbaryl Flowable Insecticide	Envirogreen Pty Ltd	47108/0599 47108/0998 47108/3260
47855	I Love My Pet Flea Powder For Cats And Dogs	My Pet Products Australia Pty Ltd	47855/01
49133	Defender Trouble Shooter Tomato Spray	Scotts Australia Pty Ltd	49133/01
49870	Defender Tomato Doctor Insecticide/Fungicide	Scotts Australia Pty Ltd	49870/01
50664	I Love My Pet Flea Rid Powder For Cats & Dogs	My Pet Products Australia Pty Ltd	50664/0598
51625	Richgro Garden Products Ready To Use Pest-Stop Tomato	A Richards Pty Ltd T/A Richgro Garden Products	51625/0499

Ψ Labels transitioned from the states and not having an approval number.

5.5 Previously approved labels

The APVMA is NOT SATISFIED that previously approved product labels, except for the most recently approved label for currently registered products listed in Table 15 contain adequate instructions in relation to the criteria set out in section 14(3)(g) of the Agvet Codes as well as those referred to in Regulations 11 and 12 of the Agvet Code Regulations. The labels contain use patterns recommended to be deleted.

On this basis previously approved labels are to be cancelled.

Table 15: Label approvals to be cancelled as not containing adequate instructions

Product number	Label approval number
32002	32002/0301 32002/0498 32002/1001
33575	33575/1200
45944	Ψ
49326	49326/1098
52472	52472/0100
54634	54634/0402

Ψ Labels transitioned from the states and not having an approval number.

6. AMENDMENTS TO STANDARDS

Arising from the assessment of data submitted to the review of carbaryl, and based on the advice of the 20th and 23rd meetings of the Advisory Committee on Pesticides and Health and consideration of the expanded toxicological database on carbaryl, the following advice is provided by the OCS.

6.1 Public health standards

6.1.1 Acceptable daily intake

At the commencement of the review, the ADI for carbaryl was 0.004 mg/kg bw/d, derived by applying a 4000-fold safety factor to a LOEL of 100 ppm (16 mg/kg bw/d) for vascular tumours occurring in male mice in a two-year dietary study. The review recommended that the ADI be revised to 0.008 mg/kg bw/d derived by applying a 2000-fold safety factor to the same LOEL of 100 ppm for vascular tumour formation.

6.1.2 Acute reference dose

Arising from the assessment of the data submitted to the review the OCS set an ARfD of 0.01 mg/kg bw, applying a 100-fold safety factor to NOELs of 1 mg/kg bw/d, established in rat 13-week subchronic and developmental neurotoxicity studies, and based on behavioural indications of autonomic neurotoxicity and brain, plasma and erythrocyte ChE depression (LOEL=10 mg/kg bw/d).

6.1.3 Water quality guidelines

The current health value for carbaryl of 0.03mg/L in drinking water remains unchanged.

6.1.4 Poisons scheduling

Carbaryl is classified as a Schedule 6 poison in the Standard for Uniform Scheduling of Drugs and Poisons (SUSDP), with Schedule 5 entries for preparations containing 10 per cent or less of carbaryl, or when impregnated into plastic resin material containing 20 per cent or less of carbaryl. Carbaryl preparations for human therapeutic use are listed in Schedule 4, but none are currently on the Australian market. Based on the decisions of the National Drugs and Poisons Schedule Committee at its 36th meeting, no changes are recommended to the Poisons Schedule status of carbaryl.

6.1.5 First aid instructions

The following amended standard statements for carbaryl (Table 16) will be specified in the *Handbook of First Aid Instructions, Safety Directions, Warning Statements and General Safety Precautions for Agricultural and Veterinary Chemicals* (FAISD Handbook) (OCS, 2002), see http://www.health.gov.au/ocs/docs/pdf/faisd.pdf.

In the current first aid instructions, statement **'h'** must appear on the labels of several HG products, comprising an 18 g/kg BA, five LD or SC products containing between 60 and 100 g carbaryl/L, and two wettable powders (WPs) containing carbaryl at 100 and 115 g/kg respectively. The acute oral, dermal and inhalation toxicity of these products has been

assessed as low, as is the risk of life-threatening anti-ChE poisoning. Furthermore, the carbaryl HG products would usually be stored and used in an urban environment with comparatively ready access to medical assistance and in practice, householders are unlikely to keep atropine tablets. Therefore, statement **'h'** is considered inappropriate for carbaryl-based HG products, and the threshold concentration should be raised to 12 per cent to accommodate such products.

Table 16: Amended first aid instructions for carbaryl

Concentration	Code	First aid instruction
12% or less In plastic resin strips	a	If poisoning occurs, contact a doctor or Poisons Information Centre. Phone Australia 131126; New Zealand 03 4747000
In pressurised spray packs	o	If sprayed on skin, wash thoroughly. If sprayed in mouth, rinse mouth with water.

6.1.6 Safety directions

The amended safety directions for carbaryl products are as listed in Table 17.

Table 17: Amended safety directions for carbaryl products (FAISD Handbook 31 December 2005)

Formulation	Safety direction	Statement
HG AC 60 g/L or less in hose-end sprayers	120, 130, 131, 132, 133	Product is poisonous if absorbed by skin contact or inhaled or swallowed.
	160, 162	May irritate the eyes.
	210, 211,	Avoid contact with eyes and skin.
	220, 223	Do not inhale spray mist.
	279, 283, 290, 292b, 312	When using the product wear rubber apron and rubber gloves.
	340, 341, 342	If product or spray on skin, immediately wash with soap and water.
	350	After use and before eating, drinking or smoking, wash hands, arms and face thoroughly with soap and water.
	360, 361, 366-	After each day's use, wash gloves and contaminated clothing.
HG BA 18 g/kg or less	120, 130, 131, 132, 133,	Product is poisonous if absorbed by skin contact or inhaled or swallowed.
	210, 211	Avoid contact with eyes and skin.
	220, 221,	Do not inhale dust.
	351	Wash hands after use.
HG DU 20 g/kg or less with maldison 10 g/kg or less and mancozeb 40 g/kg or less and sulfur 300 g/kg or less	120, 130, 131, 132, 133	Product is poisonous if absorbed by skin contact or inhaled or swallowed.
	160, 162, 163, 164,	May irritate the eyes and nose and throat and skin.
	180, 181	Repeated exposure may cause allergic disorders; sensitive workers should use protective clothing.
	210, 211	Avoid contact with eyes and skin.
	220, 221	Do not inhale dust.

	279, 280, 283, 290, 292b, 312	When opening the container and using the product wear cotton overalls buttoned to the neck and wrist (or equivalent clothing).
	350,	After use and before eating, drinking or smoking, wash hands, arms and face thoroughly with soap and water.
	360, 361, 366	After each day's use, wash gloves and contaminated clothing.
HG DU 20 g/kg or less with copper oxychloride 85 g/kg or less and sulfur 420 g/kg or less with calcium carbonate 215 g/kg or less	120, 130, 131, 132, 133	Product is poisonous if absorbed by skin contact or inhaled or swallowed.
	161, 162, 163, 164	May irritate the eyes and nose and throat and skin.
	180,	Repeated exposure may cause allergic disorders.
	210, 211	Avoid contact with eyes and skin.
	220, 221	Do not inhale dust.
	279, 280, 283, 290, 292b, 312	When opening the container and using the product wear cotton overalls buttoned to the neck and wrist (or equivalent clothing) and rubber gloves.
	340, 343	If product in eyes, wash it out immediately with water.
	350	After use and before eating, drinking or smoking, wash hands, arms and face thoroughly with soap and water.
	360, 361, 366	After each day's use, wash gloves and contaminated clothing.
HG SC LD 100 g/L or less	120, 130, 131, 132, 133	Product is poisonous if absorbed by skin contact, inhaled or swallowed.
	160, 162, 163, 164,	May irritate the eyes and nose and throat and skin.
	210, 211	Avoid contact with eyes and skin.
	220, 223	Do not inhale spray mist.
	279, 281, 282 283, 290, 292b, 312	When opening the container, preparing spray and using the prepared spray, wear cotton overalls buttoned to the neck and wrist (or equivalent clothing) and rubber gloves.
	340, 342	If product on skin, immediately wash area with soap and water.
	350	After use and before eating, drinking or smoking, wash hands, arms and face thoroughly with soap and water.
	360, 361. 366	After each day's use, wash gloves and contaminated clothing.
HG WP 100 g/kg or less with mancozeb 135 g/kg or less and sulfur 300 g/kg or less	120, 130, 131, 132, 133	Product is poisonous if absorbed by skin contact, inhaled or swallowed.
	160, 162, 163, 164	May irritate the eyes, nose and throat and skin.
	180	Repeated exposure may cause allergic disorders.
	210, 211	Avoid contact with eyes and skin.
	220, 221, 223	Do not inhale dust or spray mist.
	279, 280, 281, 282, 290, 292b, 312	When opening the container, preparing spray and using the prepared spray wear cotton overalls buttoned to the neck and wrist (or equivalent clothing) and rubber gloves.
	340, 342	If product on skin, immediately wash area with soap and water.
	350	After use and before eating, drinking or smoking, wash hands, arms and face thoroughly with soap and water.
	360, 361, 366	After each day's use, wash gloves and contaminated clothing.
	120, 130, 131, 132, 133	Product is poisonous if absorbed by skin contact, inhaled or swallowed.
	160, 162, 164	May irritate the eyes and skin.
	180	Repeated exposure may cause allergic disorders.

HG WP 115 g/kg or less with copper oxychloride 435 g/kg or less and sulfur 285 g/kg or less	210, 211	Avoid contact with eyes and skin.
	220, 221, 223	Do not inhale dust or spray mist.
	279, 280, 281, 282, 290, 292b, 312	When opening the container, preparing spray and using the prepared spray wear cotton overalls buttoned to the neck and wrist (or equivalent clothing) and rubber gloves.
	340, 342	If product on skin, immediately wash area with soap and water.
	340, 343	If product in eyes, wash it out immediately with water.
	350	After use and before eating, drinking or smoking, wash hands, arms and face thoroughly with soap and water.
	360, 361, 366	After each day's use, wash gloves and contaminated clothing.
HV Ear drops 10 g/L or less	120, 130, 131, 133	Product is poisonous if absorbed by skin contact or swallowed.
	161, 162, 164	May irritate the eyes and skin.
	210, 211	Avoid contact with eyes and skin.
	340, 342	If product on skin, immediately wash area with soap and water.
	340, 343	If product in eyes, wash it out immediately with water.
	351	Wash hands after use.
HV Foam 10 g/L or less with pyearethrins 1.0 g/L or less and piperonyl butoxide 10 g/L or less and coal tar 10 g/L or less with quaternary ammonium compounds 100 g/L or more	120, 130, 131, 133	Product is poisonous if absorbed by skin contact or swallowed.
	161, 162, 163, 164	May irritate the eyes and nose and throat and skin.
	210, 211	Avoid contact with eyes and skin.
	279, 280, 283, 290, 312	When opening the container and using the product wear rubber gloves.
	340, 342	If product on skin, immediately wash area with soap and water.
	340, 343	If product in eyes, wash it out immediately with water.
	350	After use and before eating, drinking or smoking, wash hands, arms and face thoroughly with soap and water.
	360, 361, 366	After each day's use, wash gloves and contaminated clothing.
HV Shampoo 10 g/L or less	120, 130, 131, 133	Product is poisonous if absorbed by skin contact or swallowed.
	161, 162, 164	May irritate the eyes and skin.
	210, 211	Avoid contact with eyes and skin.
	279, 280, 283, 290, 312	When opening the container and using the product wear rubber gloves.
	340, 342	If product on skin, immediately wash area with soap and water.
	340, 343	If product in eyes, wash it out immediately with water.
	350	After use and before eating, drinking or smoking, wash hands, arms and face thoroughly with soap and water.
	360, 361, 366	After each day's use, wash gloves and contaminated clothing.

AL = other liquids to be applied undiluted; DU = dust; EC = emulsifiable concentrate; HG = home garden; LC = liquid concentrate, HV = home veterinary, BA =

6.1.7 Warning statement

For any product applied on and around the exterior of domestic premises, the label should bear the additional warning statement: 'Avoid bare skin contact with treated surfaces for 7 days'.

APPENDICES

Appendix A: Products and associated label approvals considered as part of the reconsideration of carbaryl home garden, home veterinary, poultry and domestic products

Product number	Product name	Registrant	Label approval number
31995	CRG Liquid Carbaryl Insect Spray	Chemical Recovery Co Pty Ltd	31995/0798
31997	Chemspray Carbaryl Insecticide	Envirogreen Pty Ltd	31997/0802
32002	Yates Carbaryl Caterpillar & Grasshopper Insect Spray	Arthur Yates & Co Limited	32002/0202 32002/0301 32002/0498 32002/1001
33575	Fido's Fre-Itch Flea Shampoo For Cats And Dogs	Mavlab Pty Ltd	33575/1002 33575/1200
33576	Saint Bernard Flea Powder For Dogs And Cats	Saint Bernard Pet Care Pty Ltd	33576/01 33576/0402 33576/0801
36387	Watch Cat Flea Powder For Cats	Go-Pet Petcare Solutions a division of Nestle Australia Ltd	36387/0299 36387/1198
36388	Watch Dog Flea Powder For Dogs	Go-Pet Petcare Solutions a division of Nestle Australia Ltd	36388/0299 36388/1198
37434	Fido's Fre-Itch CPP Flea Powder For Cats And Dogs	Mavlab Pty Ltd	37434/0101
39082	Hortico Hose-On Lawn Grub Killer	Orica Australia Pty Ltd	39082/0700
39864	Yates Lanosan Tomato Spray Insecticide And Fungicide	Arthur Yates & Co Limited	39864/0500 39864/0598
39876	Yates Garden Spray Insecticide Fungicide	Arthur Yates & Co Limited	39876/0998
39998	Fido's Ear Drops	Mavlab Pty Ltd	39998/0101
40080	Fido's Fre-Itch Flea Powder For Cats And Dogs	Mavlab Pty Ltd	40080/0402
41244	David Skatta-7 Tick Flea Louse Powder	Bocko P/L & Trademarketing Solutions P/L T/A Pharmachem	41244/0901
42054	David Grays Tomato Dust	David Gray & Co. Pty Limited	42054/02
42055	David Grays Vegetable Dust	David Gray & Co. Pty Limited	42055/02
42261	David Grays Cricket & Grasshopper Killer Bait	David Gray & Co. Pty Limited	42261/1202
45944	Garden King Multipest S-C-C General Purpose Insecticide-Fungicide-Miticide	Envirogreen Pty Ltd	Ψ
46851	Keydust Dusting Powder	International Animal Health Products Pty Ltd	46851/0100
47966	I Love My Pet Ear Drops Ear Cleaner & Treatment For Cats And Dogs	My Pet Products Australia Pty Ltd	47966/01
48753	Tomato Dust Insecticide & Fungicide	Crop Care Australasia Pty Ltd	48753/01
49325	Kendon Carbaryl Liquid Insecticide	Kendon Chemicals & Mnfg Co Pty Ltd	49325/0400 49325/1098
49326	Kendon Carbaryl Wettable Powder Insecticide	Kendon Chemicals & Mnfg Co Pty Ltd	49326/0400 49326/1098
49937	Garden King Carbaryl Liquid Insecticide	Envirogreen Pty Ltd	49937/0802 49937/1097
50102	Friskies Kill Flea Carpet Deodoriser	Go-Pet Petcare Solutions a division of Nestle Australia Ltd	50102/0798
50741	I Love My Pet Flea Rid Shampoo For Dogs & Cats	My Pet Products Australia Pty Ltd	50741/0598
51206	Family Pets Flea & Tick Pet Grooming Powder For Dogs, Cats, Puppies And Kittens	Aristopet Pty Ltd T/A Family Companion Pet Products	51206/0998
52472	Garden King Tomato & Vegetable Dust	Envirogreen Pty Ltd	52472/0100

Product number	Product name	Registrant	Label approval number
	Insecticide & Fungicide		52472/0702
52493	Richgro Garden Products Carbaryl Caterpillar & Grasshopper Insecticide	A Richards Pty Ltd T/A Richgro Garden Products	52493/0300
53231	Hortico Cabbage Dust	Orica Australia Pty Ltd	53231/0700
53260	Hortico Tomato Dust	Orica Australia Pty Ltd	53260/0700
53912	Yates Ready To Use Tomato Gun Pest & Disease Spray	Arthur Yates & Co Limited	53912/0702
54634	Richgro Garden Products Armyworms, Cockchafers & Lawn Grub Killer	A Richards Pty Ltd T/A Richgro Garden Products	54634/0402
54949	David Grays Carbaryl Liquid Insecticide	David Gray & Co. Pty Limited	54949/0102
57952*	Go-Pet Kill Flea Carpet Deodoriser	Go-Pet Petcare Solutionsa division of Nestle Australia ltd	57952/0903
58127*	Yates Insect & Disease Control Blitzem Tomato Gun	Orica Australia Pty Ltd	58127/0903
58135*	Yates Insect & Disease Control Blitzem Tomato Dust	Orica Australia Pty Ltd	58135/0903
59431*	Yates Insect & Disease Control Blitzem Lanosan Tomato Spray	Orica Australia Pty Ltd	59431/0105

Ψ Labels transitioned from the states and not having an approval number.

*Products registered after the commencement of the extended scope of the review, that are subject to the outcomes of the review.

Appendix B: Toxicology hazard profile

Absorption, distribution, metabolism and excretion in mammals

Rate and extent of oral absorption	Oral absorption is rapid and extensive in humans, rodents and other species. Dermal absorption from aqueous media is slow and saturable in rodents but enhanced in the presence of organic solvents. Pulmonary absorption is rapid.
Distribution	Small amounts in carcass, kidney and liver.
Potential for accumulation	Very low.
Rate and extent of excretion	Rapid, extensive, predominantly via urine in all species except dog.
Metabolism	Rapid. Proceeds via hydrolysis, alkyl oxidation, arene oxide formation, epoxide hydrolysis and glutathione conjugation. Pathways similar in humans, rodents and other species investigated.
Toxicologically significant compounds (animals, plants and environment)	Reactive epoxide intermediates may be formed in mice and rats.

Acute toxicity

Rat oral LD_{50} (mg/kg bw)	246
Worst oral LD_{50} in other species	150 mg/kg bw in cats
Rat dermal LD_{50} (mg/kg bw)	No data
Worst dermal LD_{50} in other species	>2000 mg/kg bw in rabbits
Rat inhalation LC_{50} (mg/m^3)	2500 (4h) as aerosol
Worst inhalation LC_{50} in other species	No data
Skin irritation	Classified as slight in rabbits
Eye irritation	Classified as not irritating in rabbits
Skin sensitiation	None in guinea pigs

Metabolites of carbaryl

Rat oral LD_{50} (mg/kg bw)	
4-hydroxycarbaryl	1190
5-hydroxycarbaryl	297
7-hydroxycarbaryl	4760
hydroxymethylcarbaryl	>5000
1-naphthol	2570

Short-term toxicity

Target/critical effect	ChE depression, cholinergic symptoms
Lowest relevant oral NOEL (mg/kg bw/d)	1 in rats (13-wk neurotoxicity study by gavage)
Lowest relevant dermal NOEL (mg/kg bw/d)	No data

Lowest relevant inhalation NOEC (mg/m^3)	10 in rats (90-d study, highest dose tested)

Genotoxicity

Genotoxicity	Clastogenic *in vitro* but not *in vivo*. Interrupts spindle formation *in vitro*. Overall weight of evidence lies against mutagenicity or genotoxic activity by other mechanisms.

Long-term toxicity and carcinogenicity

Target/critical effect	Kidney: cloudy swelling of tubules
Lowest relevant NOEL (mg/kg bw/d)	1.8 in 1-yr dog study by gavage
Carcinogenicity	Vascular tumours in male mice in a 2-yr dietary study at 16 mg/kg bw/d, the lowest dose tested. At the highest dose (1350 mg/kg bw/d), there was also development of renal adenoma and carcinoma in males, while hepatic adenoma and carcinoma became elevated in females. At the high dose of 420 mg/kg bw/d in a 2-yr rat dietary study, there was treatment-related formation of urinary bladder papilloma/carcinoma in both sexes, renal carcinoma and thyroid adenoma/carcinoma in males, and hepatic adenoma in females.

Reproductive toxicity

Reproduction target/critical effect	Decreased parental bw gain, bw, feed consumption and conversion efficiency, depressed gestation and lactation bw in rat dams, and increased pup mortality.
Lowest relevant reproductive NOEL (mg/kg bw/d)	4.7 in rats
Developmental target/critical effect	Skeletal and visceral abnormalities in dogs at and above 6.3 mg/kg bw/d in the absence of maternal toxicity.
Lowest relevant developmental NOEL (mg/kg bw/d)	3.1 in dogs
Delayed neurotoxicity	No effects
Immunotoxicity	No data

Dermal absorption

Dermal absorption	In rat: Up to 2% of applied dose over 30 min, rising to a maximum of 25% at 24 h. Results obtained with formulated product applied in aqueous CMC vehicle. In humans: Up to 4.4% over 4 h and16% over 8 h, applied in acetone vehicle.

Summary

ADI 0.008 mg/kg bw/d, based on vascular tumour formation.
Acute RfD 0.01 mg/kg bw based on ChE inhibition, clinical signs, and reduced bw gain.

NOEL (mg/kg bw/d)	Study	Safety factor
16 mg/kg bw/d*	2-yr dietary study in mice	2000[#]
1 mg/kg bw/d	13-wk neurotoxicity and developmental neurotoxicity studies by gavage in rats	100

*LOEL value.
[#]The safety factor incorporates a 10-fold component for interspecies extrapolation, a 10-fold component for intraspecies variability, a 5-fold component for adequacy of the database, and a 4-fold component for seriousness of the carcinogenic response. (This 4-fold component comprises a 1-fold factor (low degree of confidence that carbaryl is genotoxic), a 4-factor (medium degree of confidence that carbaryl causes malignant tumours) and a further 1-fold factor (metastases not reported)).

Health value in drinking water	Current: 0.03 mg/L