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**Australian Pesticides and
Veterinary Medicines Authority**



CARBENDAZIM

PRELIMINARY REVIEW FINDINGS: TECHNICAL REPORTS

VOLUME THREE: RESIDUES EVALUATION REPORT
Review of dietary exposure

MAY 2011

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1 INTRODUCTION

Carbendazim and thiophanate-methyl were placed under review by the APVMA in 2007 because of occupational health and safety, residue and public health concerns. Carbendazim has a range of uses approved by registration and permit which include uses as foliar sprays and post harvest dips.

Registrants were notified of the requirement to provide all existing residues data for carbendazim and thiophanate-methyl in March 2007 and an additional specific request was made for residue data for post harvest dip uses (apples, pears, citrus, banana, mango, rockmelon, and stone fruit) and for uses on grapes.

The revised toxicology assessment for carbendazim has been completed. The outcomes of the toxicology assessment were the confirmation of the Acceptable Dietary Intake (ADI) of 0.03 mg/kg/day and the establishment of an Acute Reference Dose (ARfD) of 0.05 mg/kg/day (end point of testicular toxicity in rats, single dose study, LOEL of 50 mg/kg (NOEL not determined), ×1000 safety factor). The establishment of the ARfD requires a contemporary assessment of dietary exposure associated with approved uses.

Label and maximum treatment regime

Food producing uses under permit and on label (March 2009) are summarised below. Uses on timber and ornamental crops are not considered in this report as they are not food producing situations.

Table 1 Use patterns Fruits and Vegetables

CROP	PEST	PRODUCT DESCRIPTION	MAXIMUM RATE	WHPS	CRITICAL COMMENTS
Cucurbits	Powdery Mildew (<i>Sphaerotheca fuliginea</i>)	500g/L SC 500g/kg WP	50mL/100L or 550mL/ha 50g/100L or 500g/ha	-	Begin application when disease first appears, repeat at 7 to 14 day intervals. Use the higher rate and shorter intervals when disease pressure is high and plants are growing rapidly.
Mushrooms (<i>Agaricus bisporus</i>) Permit 11704	For the control of dry bubble (<i>Verticillium fungicola</i>), wet bubble (<i>Mycogone perniciosa</i>) and green mould (<i>Trichoderma</i>)	500 g/L SC 500g/kg WP	LIQUID 500 g/L formulations: 2.5ml / 1L water per 100kg casing material or 2.5ml / 1L water per 1 square metre of bed surface. WP 500 g/kg: apply at rate of 2.5grams / 100kg casing material or 2.5grams / 1 square metre of bed surface.		To be applied only once per crop when preparing casing material from peat moss. <i>This is NOT on the label as it is a Permit use current at the time of preparation of this table</i>

CROP	PEST	PRODUCT DESCRIPTION	MAXIMUM RATE	WHPS	CRITICAL COMMENTS
Strawberries	Grey mould (<i>Botrytis cinerea</i>)	500g/L SC 500g/kg WP	50mL/100L 50g/100L	2 days	Begin application when disease first appears or at flowering and repeat at 7 to 14 day intervals. Use higher rate and shorter intervals when disease pressure is high.

Table 2 Use patterns Tree and vine crops

CROP	PEST	PRODUCT DESCRIPTION	MAXIMUM RATE	WHPS	CRITICAL COMMENTS
Apples	Powdery Mildew (<i>Podosphaera leucotricha</i>)	500g/L SC 500g/kg WP	50mL/100L (1L/ha) 50g/100L	7 days	Apply at 7 to 10 day intervals until petal fall. Use higher rate when disease pressure is high.
	Black spot (Scab) (<i>Venturia inaequalis</i>)				
Custard apples	<i>Cylindrocladium</i> spp., <i>Pseudocercospora</i> spp.	500g/L SC	50mL/100L	3 days	DO not apply in tank mixes with products containing Copper oxychloride. Apply a maximum of 4 sprays. First spray to be applied at fruit set after flowering. Where disease has occurred previously apply a second spray 2 – 4 weeks later. If high disease pressure should occur, a further two sprays may be applied. All sprays must be applied at a minimum interval of 14 days.
Grapes	Grey mould (Bunch rot) (<i>Botrytis cinerea</i>)	500g/L SC 500g/kg WP	100mL/100L or 1.1L/ha 100g/100L or 1.1kg/ha	1 day	Apply at early flowering, 80 to 100% capfall and pre-bunch closure. Further applications may be necessary at veraison and pre-harvest, if wet weather favours infection. Application should be made in sufficient water to obtain thorough coverage of the crop. High volume application should be made in sufficient water to obtain thorough coverage of the crop. For applications close to harvest this would require a minimum of 1100 L/ha. For low volume application, the spray pressure should be high enough to ensure penetration of the leaf canopy and coverage of the bunches.

CROP	PEST	PRODUCT DESCRIPTION	MAXIMUM RATE	WHPS	CRITICAL COMMENTS
Macadamia nuts	Macadamia husk spot (<i>Pseudocercospora</i> spp.)	500g/L SC	50mL/100L (1L/ha) plus wetting agent at 100mL/100L	14 days (Harvest) (Graze or cut for stock feed) 4 weeks. (One label has 2 weeks)	Apply at 5 and 8 weeks after main flowering – stage 2 anthesis (white flowering stage). Remove any fallen nuts from under trees prior to spraying. DO NOT apply more than 2 applications per season.
Mango Permit	Powdery mildew	500 g/L SC	Apply at the rate of 40 or 50 mL / 100L	-	Apply to new flush growth. Use the higher rate when disease pressure is high.
Pears	Black spot (Scab) (<i>Venturia pirina</i>)	500g/L SC 500g/kg WP	50mL/100L (1L/ha) 50g/100L	7 days	Apply at 7 to 10 day intervals until petal fall. Use higher rate when disease pressure is high.
Stone fruit	Blossom blight (<i>Monilinia fructicola</i>)	500g/L SC 500g/kg WP	50mL/100L (1L/ha) 50g/100L	1 day	Apply at pink or white bud stage, 10% blossom and petal fall. Apply the higher rate when disease pressure is high.
	Brown rot (<i>Monilinia fructicola</i>)	500g/L SC 500g/kg WP	40mL/100L 40g/100L		Apply 3 and 1 week prior to harvest following earlier application of blossom blight sprays

Table 3 Use patterns Post-harvest treatments

CROP	PEST	PRODUCT DESCRIPTION	MAXIMUM RATE	WHPS	CRITICAL COMMENTS
Apples	Blue mould (<i>Penicillium expansum</i>)	500g/L SC 500g/kg WP	50mL/100L 50g/100L	-	Submerge fruit for approximately 30 seconds. Dipping should occur no later than 24 hours after harvest. Top up dip at the recommended rate of 50mL/100L. TAS only: Always apply the treatment whenever the apples are to be dipped in diphenylamine prior to storage.
Bananas	Crown rot (<i>Colletotrichum musae</i>)	500g/L SC 500g/kg WP	40mL/100L 40g/100L	-	Submerge fruit for approximately 30 seconds.
Citrus	Blue and green moulds (<i>Penicillium</i> spp.)	500g/L SC 500g/kg WP	100mL/100L 100g/100L 0.05%	-	Submerge fruit for approximately 30 seconds.

CROP	PEST	PRODUCT DESCRIPTION	MAXIMUM RATE	WHPS	CRITICAL COMMENTS
Mangoes	Anthracnose (<i>Colletotrichum</i> spp.), Stem end rot (<i>Dothiorella</i> spp.)	500g/L SC	100mL/100L	-	Submerge for approximately 5 minutes at 52 °C.
Pears	Blue mould (<i>Penicillium expansum</i>)	500g/L SC 500g/kg WP	50mL/100L 50g/100L	-	Submerge fruit for approximately 30 seconds. Dipping should occur no later than 24 hours after harvest. Top up dip at the recommended rate of 50mL/100L.
Rockmelons	Fusarium fruit rot (<i>Fusarium</i> spp.), Sour rot (<i>Geotrichum candidum</i>), Alternaria fruit rot (<i>Alternaria</i> spp.), Rhizopus soft rot (<i>Rhizopus stolonifer</i>), Pink mould rot (<i>Trichothecium roseum</i>)	500g/L SC	100mL/100L plus 130mL Panoptine plus 10mL Chemwet 1000/100L water	-	Dip fruit for 45 seconds within 24 hours of harvest.
Stone fruit	Brown rot (<i>Monilinia</i> spp.), <i>Sclerotinia</i> spp.)	500g/L SC 500g/kg WP	100mL/100L 50g/100L	-	Submerge fruit for approximately 30 seconds. Use higher rate when disease pressure is severe or when longer term storage is required.

Table 4 Use patterns Pre-planting treatments

CROP	PEST	PRODUCT DESCRIPTION	MAXIMUM RATE	WHPS	CRITICAL COMMENTS
Ginger seed pieces	Rhizome / seed piece rot (<i>Fusarium</i> spp.)	500g/L SC 500g/kg SC	200mL/100L 200g/100L	-	Cut seed pieces to desired length from rhizomes free of rot. Submerge for 5 minutes and allow to dry before planting.
Sugar cane	Pineapple disease (<i>Ceratocystis paradoxa</i>)	500g/L SC 500g/kg	65mL/100L 125mL/200L 125g/200L		Apply to cut seed pieces as a dip or spray so as to obtain thorough wetting. After dipping allow to drain. When replenishing dip, top up with 65 mL (125mL or 125g) in 100L water.

CROP	PEST	PRODUCT DESCRIPTION	MAXIMUM RATE	WHPS	CRITICAL COMMENTS
Permit 8170 Onion bulbs post harvest for seed production only	Botrytis, sclerotina, anthracnose, penicillium	500g/L SC	Prepare dip containing 100ml/100L Top up dip at rate 100ml/100L	-	Submerge bulbs for 5-10 minutes. Bulbs may require 2-3 dips per season. <i>This is NOT on the label as it is a Permit use current at the time of preparation of this table</i>

Table 5 Field Crops and Pastures

CROP	PEST	PRODUCT DESCRIPTION	MAXIMUM RATE	WHPS	CRITICAL COMMENTS
Chickpeas, faba beans, lentils and vetch	Chocolate spot (<i>Botrytis fabae</i>), grey mould (<i>Botrytis cinerea</i>)	500g/L SC	500mL/ha	4 weeks (H,G)	Apply a maximum of two consecutive applications at 14 day intervals. Apply in a minimum of 100L water per hectare.
Pasture	Clover scorch (<i>Kabatiella caulivora</i>) Cercospora (<i>Cercospora zebrina</i>)	500g/L SC	550mL/100L plus 1L/100L summer spray oil	Stock graze or cut vegetation 14 days	Apply at 'closing up' of pasture in a minimum spray volume of 150 L/ha. Repeat 30 days later if there is a build up of disease. Use the higher rate if disease is well established at 'closing up', repeat at this rate 30 days later if disease continues to develop.
Red clover, Subterranean clover	Clover scorch (<i>Kabatiella caulivora</i>) Cercospora (<i>Cercospora zebrina</i>)	500g/L SC 500g/kg WP	550mL/100L plus 1.5L/150L summer spray oil 550g/100L plus 1.5L/100L petroleum oil	Stock graze or cut vegetation 14 days	Apply at 'closing up' of pasture in a minimum spray volume of 150 L/ha. Repeat 30 days later if there is a build up of disease. Use the higher rate if disease is well established at "closing up", repeat at this rate 30 days later if disease continues to develop.
Permit 9467 Pyrethrum	Sclerotinia Sclerotium	500g/L SC	750mL per ha	DO NOT apply within 14 days of windrowing	Apply no more than 2 applications at 7-10 day intervals, beginning at 2% flowering. Apply using a tractor mounted boom spray. <i>This is NOT on the label as it is a Permit use current at the time of preparation of this table</i>

2 MRLS AND CURRENT USES

The current Australian and Codex residue definition for carbendazim is:

Sum of carbendazim and 2-aminobenzimidazole, expressed as carbendazim

Residues of carbendazim can also arise from the use of benomyl, thiophanate and thiophanate-methyl. The last registrations of benomyl and thiophanate products either expired or were voluntarily withdrawn in 2004. Thiophanate-methyl is registered for use on ornamentals and as such there are no food producing uses of thiophanate-methyl. Benomyl, thiophanate and thiophanate-methyl will not be considered further in this evaluation.

Current entries in Table 1 and Table 4 of the MRL Standard for carbendazim are summarised below.

Table 6 Current entry for carbendazim in Table 1 of the MRL Standard

COMPOUND	FOOD		MRL (mg/kg)
Carbendazim			
	FI 0326	Avocado	3
	FI 0327	Banana	1
	FB 0018	Berries and other small fruits [except grapes]	5
	GC 0080	Cereal grains	*0.05
	FC 0001	Citrus fruits	10
	FI 0332	Custard apple	1
	MO 0105	Edible offal (mammalian)	0.2
	PE 0112	Eggs	*0.1
	VC 0045	Fruiting vegetables, Cucurbits [except melons, except Watermelons]	2
	VO 0050	Fruiting vegetables, other than Cucurbits [except mushrooms]	2
	HS 0784	Ginger, root	10
	FB 0269	Grapes	3
	HH 0092	Herbs	T3
		Kaffir lime leaves	T3
		Lemon balm	T3
		Lemon grass	T3
	DT 1111	Lemon verbena	T3

COMPOUND	FOOD		MRL (mg/kg)
	FI 0343	Litchi	10
	FI 0345	Mango	5
	MM 0095	Meat [mammalian]	0.2
	VC 0046	Melons, except Watermelons	4
	ML 0106	Milks	*0.1
	TN 0669	Macadamia nuts	0.1
	VO 0450	Mushrooms	10
	FI 0350	Papaya	T20
	SO 0697	Peanut	0.2
	TN 0675	Pistachio nut	T0.1
	FP 0009	Pome fruits	5
	PO 0111	Poultry, Edible offal of	*0.1
	PM 0110	Poultry meat	*0.1
	VD 0070	Pulses	0.5
	FS 0012	Stone fruits	10
	GS 0659	Sugar cane	0.1
	HS 0794	Turmeric, root	T3
		Vegetables [except fruiting vegetables, cucurbits; fruiting vegetables, other than cucurbits; mushrooms; pulses]	3

Table 7 Current entry for carbendazim in Table 4 of the MRL Standard

COMPOUND	ANIMAL FEED COMMODITY		MRL (MG/KG)
Carbendazim			
	AL 0157	Legume animal feeds	25

There are no entries for carbendazim in Table 5 of the MRL Standard.

3 RESIDUES ASSESSMENT

3.1 MRLs without associated use patterns.

A number of MRLs no longer have associated uses. They were previously associated with carbendazim or benomyl use patterns and will be deleted from the MRL Standard. Those MRLs are shown:

Table 8 MRLs with no associated use patterns to be deleted from Table 1 of the MRL Standard

COMPOUND	FOOD		MRL (mg/kg)
Carbendazim	DT 1111	Lemon verbena	T3
	FI 0326	Avocado	3
	FI 0343	Litchi	10
	FI 0350	Papaya	T20
	GC 0080	Cereal grains	*0.05
	HH 0092	Herbs	T3
		Kaffir lime leaves	T3
		Lemon balm	T3
		Lemon grass	T3
	HS 0794	Tumeric, root	T3
	SO 0697	Peanut	0.2
	TN 0675	Pistachio nut	T0.1
	VO 0050	Fruiting vegetables, other than Cucurbits [except mushrooms]	2

3.2 Acute Dietary Exposure

Acute dietary exposure is estimated by the National Estimated Short Term Intake (NESTI) calculation. The NESTI calculations are made in accordance with the deterministic method used by the JMPR with 97.5th percentile food consumption data derived from the 1995 National Nutrition Survey of Australia. NESTI calculations are conservative estimates of acute exposure (24 hour period) to chemical residues in food.

The NESTI calculations are attached at Appendix 3. In most cases the MRL is used in the calculation as there are insufficient data to allow further refinements of the estimates. The ARfD is exceeded for a number of commodities. Each of the MRLs and associated uses will be discussed below.

3.2.1 Berries and other small fruits

Table 9: NESTIs calculations Berries and small fruits

COMMODITY	MRL (mg/kg)	%ACUTE REFERENCE DOSE (ARFD)	
		2-6 YEARS	2+ YEARS
Commodity	MRL (mg/kg)	NESTI (% ARfD)	
		2-6 yo	2+ yo
FB 0269 Grapes (excluding wine)	3	108	46
FB 0018 Berries and other small fruits [except grapes]	5	93	24

Strawberries and grapes are the only commodities in this group with currently approved uses for carbendazim. Trials evaluated by the 1998 JMPR for grapes indicated that residues at a 0 day WHP (next 6-7 days) following 4 treatments at 0.4 to 0.5 kg carbendazim/ha (0.7x - 0.9x) ranged from 0.76 mg/kg to 3.3 mg/kg. The NESTI for grapes exceeds the ARfD and the continued use of carbendazim on grapes according to the label directions is not supported.

Limited data for strawberries in JMPR 1998 (Appendix 1) suggest the current group MRL is appropriate for strawberries (HR of 2.5 mg/kg, 1 day PHI, 0.045 kg carbendazim/ha (1.8x), Italy) and that the NESTI would not exceed the ARfD. However Australian data is not available and full studies submitted to the 1998 JMPR have not been provided for evaluation. The use on strawberries cannot be supported at this time and the *Berries and other small fruits* MRL should be removed from the MRL Standard.

Recommendation:

1. The approved use for strawberries is no longer supported and the Berries and other small fruits MRL should be removed from the MRL Standard.
2. The approved use for grapes is no longer supported and the MRL for grapes should be removed from the MRL Standard.

3.2.2 Citrus fruits

Table 10: NESTIs calculations Citrus fruits

COMMODITY	MRL (mg/kg)	%ACUTE REFERENCE DOSE (ARFD)	
		2-6 YEARS	2+ YEARS
FC 0001 Citrus fruits – group		1435	449
FC 0004 Oranges	10	1466	544
FC 0204 Lemon		530	114
FC 0206 Mandarin		534	149

Currently approved uses are for a post harvest dip on citrus. Data are not available to support the established MRL for this use and the NESTI exceeds the ARfD. A processing study summarised by

JMPR (benomyl 1998; (residues as carbendazim) Appendix 1) included both foliar pre-harvest and a post harvest use of benomyl and determined processing factors from the raw commodity of 0.12 to washed fruit and 0.012 to pulp. While the processing study incorporated both pre- and post-harvest use it does indicate the potential for residues to be present on washed fruit.

Recommendation: The approved use for citrus is no longer supported and the MRL for citrus should be removed from the MRL Standard.

3.2.3 Tropical fruits, inedible peel

Table 11: NESTIs calculations Tropical fruits inedible peel

COMMODITY	MRL (mg/kg)	%ACUTE REFERENCE DOSE (ARFD)	
		2-6 YEARS	2+ YEARS
FI 0327 Banana	1	46	13
FI 0332 Custard apple	1 / 0.85 (HR)	121	32
FI 0345 Mango	5	592	169

Carbendazim is approved for post harvest use on bananas. Residue data are not available for the use and it can no longer be supported in the absence of such data.

The custard apple use is foliar and is supported by Australian residue data. On the basis of the available data the NESTI exceeds the ARfD and therefore the use can no longer be supported.

Australian residues data is available for mangoes and was collected following treatment at the registered GAP for post harvest use (Appendix 1). No data are available to support the foliar use and it can no longer be supported. For the post-harvest use, the high residue (HR) observed in the edible portion (flesh) was 1.7 mg/kg. The NESTI exceeds the ARfD (on both the basis of edible portion and HR in flesh) and the use can no longer be supported.

Recommendation:

1. Continued use on banana is not supported at this time and the banana MRL should be removed from the MRL Standard.
2. Use on custard apple is no longer supported and the custard apple MRL should be removed from the MRL Standard.
3. Uses on mango are no longer supported and the mango MRL should be removed from the MRL Standard.

3.2.4 Fruiting vegetables, Cucurbits

Table 12: NESTIs calculations Fruiting vegetables, cucurbits

COMMODITY	MRL (mg/kg)	%ACUTE REFERENCE DOSE (ARFD)	
		2-6 YEARS	2+ YEARS
VC 0045 Fruiting vegetables, Cucurbits [except melons, except Watermelons]	2	190	54
VC 0046 Melons, except Watermelons	4	485	187

The use pattern for cucurbits is as a foliar use for cucurbits generally and post harvest treatment of rockmelons. Available data indicate that the MRL for Melons, except Watermelons is appropriate however based on the established MRL the NESTI exceeds the ARfD. For the foliar use, overseas data are available for cucumbers, gherkins, summer squash, melons and watermelons in the 1998 JMPR (Appendix 1). However Australian data is not available and full studies submitted to the 1998 JMPR have not been provided for evaluation.

Recommendation:

1. The approved use for cucurbits as a foliar spray and post harvest treatment is no longer supported due to exceedences of the ARfD.
2. The current MRL for Fruiting vegetables, Cucurbits [except melons, except Watermelons] should be removed from the MRL Standard.
3. The MRL for Melons, except Watermelons should be removed from the MRL Standard.

3.2.5 Fruiting vegetables, other

Table 13: NESTIs calculations Fruiting vegetables, other

COMMODITY	MRL (mg/kg)	%ACUTE REFERENCE DOSE (ARFD)	
		2-6 YEARS	2+ YEARS
VO 0450 Mushrooms	10	56	33

Data have not been provided to support the use on mushrooms. The use can no longer be supported and the MRL should be removed from the MRL Standard.

Recommendation: There approved use for mushrooms is no longer supported and its MRL should be removed from the MRL Standard.

3.2.6 Bulb vegetables

Table 14: NESTIs calculations Bulb vegetables

COMMODITY	MRL (mg/kg)	%ACUTE REFERENCE DOSE (ARFD)	
		2-6 YEARS	2+ YEARS
Vegetables [except fruiting vegetables, cucurbits; fruiting vegetables, other than cucurbits; mushrooms; pulses]	3	-	-
Onion	3	60	28

The only member of this group with an approved use pattern is onions as a post harvest dip (bulbs) for seed production. Residue data are not available and the use can no longer be supported. The vegetables group MRL should be removed from the MRL Standard.

Recommendation: The approved use on onions is not supported and the Vegetables group MRL should be removed from the MRL Standard.

3.2.7 Herbs, spices and teas

Table 15: NESTIs calculations herbs, spices and teas

COMMODITY	MRL (mg/kg)	%ACUTE REFERENCE DOSE (ARFD)	
		2-6 YEARS	2+ YEARS
HS 0781 Ginger, root	10	6	6

The currently approved use is for treatment of ginger seed pieces. Residue data are not available and the use can no longer be supported. The Ginger, root MRL should be removed from the MRL Standard.

Recommendation: The approved use on ginger seed pieces is not supported and the MRL for Ginger, root should be removed from the MRL Standard.

3.2.8 Tree nuts

Table 16: NESTIs calculations Tree nuts

COMMODITY	MRL (MG/KG)	%ACUTE REFERENCE DOSE (ARFD)	
		2-6 YEARS	2+ YEARS
TN 0669 Macadamia nuts	0.1	0.3	0.2

There is an approved use for macadamia nuts that is supported by a contemporary evaluation for product 52878. Some labels have conflicting advice on grazing withholding periods. The correct grazing withholding period for macadamia plantations is 4 weeks based on the data evaluated as part of the application for the extension of use to macadamias.

Recommendations:

- The use on macadamias continues to be supported.
- Grazing withholding periods for this use should be 4 weeks

3.2.9 Pome fruits

Table 17: NESTIs calculations Pome fruits

COMMODITY	MRL (mg/kg)	%ACUTE REFERENCE DOSE (ARFD)	
		2-6 YEARS	2+ YEARS
FP 0009 Pome fruits		696	158
FP 0226 Apple	5	613	146
FP 0230 Pear		391	111
FP 0009 Pome fruits – JMPR foliar HR	0.9 (HR)	125	28

There are currently approved uses on apples and pears both as foliar application and as a post harvest dip. Data are not available to support the post harvest use and Australian data are not available for the registered foliar use. Continued use on pome fruit according to the registered foliar and post harvest use patterns cannot be supported as the NESTI exceeds to ARfD. Data from JMPR 1998 (8 trials undertaken in Germany; Appendix 1) indicate that the foliar use may also result in exceedences of the ARfD.

A carbendazim processing study is not available for pome fruit. JMPR (1998) evaluated a benomyl processing study undertaken following foliar application that indicated some reduction in residues on commercial packing lines. Prior to further consideration of either foliar or post harvest use appropriate Australian residue data and processing studies would be required for evaluation.

Recommendation: Uses as a foliar spray and post harvest dip for pome fruit are no longer supported and the MRLs should be removed from the MRL Standard.

3.2.10 Stone fruits

Table 18: NESTIs calculations Stone fruits

COMMODITY	MRL (mg/kg)	%ACUTE REFERENCE DOSE (ARFD)	
		2-6 YEARS	2+ YEARS
FS 0012 Stone fruits		461	177
FS 0240 Apricots		555	112
FS 0244 Cherries	10	342	42
FS 0245 Nectarine		589	250
FS 0247 Peach		635	216
FS 0248 Plum		520	169

There are currently approved uses on stone fruits both as foliar application and as a post harvest dip. Residue data based on carbendazim use is not available for the foliar or post harvest use. JMPR 1998 reported residues of carbendazim of up to 4.1 mg/kg in peaches at a 6 day PHI following 3 treatments of benomyl at 30 g ai/hl. The NESTI for stone fruit remains above the ARfD (189% 2-6yo, 73% 2+ yo) when an HR of 4.1 mg/kg is applied. As the NESTI exceeds the ARfD the registered foliar and post harvest uses can no longer be supported.

Recommendation: The carbendazim uses for stone fruit should be no longer supported and the MRLs should be removed.

3.2.11 Sugar cane

Table 19: NESTIs calculations Sugar cane

COMMODITY	MRL (mg/kg)	%ACUTE REFERENCE DOSE (ARFD)	
		2-6 YEARS	2+ YEARS
GS 0659 Sugar cane	0.1	1.8	0.6

There is an approved use for pre-plant dip of sugar cane seed pieces. Residue data are not available and the use is not supported. The MRL should be removed from the MRL Standard.

Recommendation: Carbendazim use on sugar cane seed pieces is no longer supported and the MRL should be removed from the MRL Standard.

3.2.12 Pulses

Table 20: NESTIs calculations - pulses

COMMODITY	MRL (mg/kg)	%ACUTE REFERENCE DOSE (ARFD)	
		2-6 YEARS	2+ YEARS
VD 0070 Pulses	0.5	8	2.4

There are approved uses of carbendazim as a foliar treatment on chickpeas, faba beans, lentils and vetch. The uses are supported by a contemporary residues evaluation for product number 52878.

Recommendation: The registered use on pulses continues to be supported.

3.2.13 Uses on pasture

Foliar uses are currently approved on pasture, red clover and subterranean clover at 250 g ai/ha with a 14 day grazing withholding period for the control of clover scorch and *Cercospora zebrina*. The specified diseases should limit treatment to legume dominant pastures¹. Residues data for pasture and clovers are not available and the uses can no longer be supported.

Recommendations:

The approved uses on pasture, red clover and subterranean clover are no longer supported.

3.2.14 Animal commodities

Table 21: NESTIs calculations - animal commodities

COMMODITY	MRL (mg/kg)	%ACUTE REFERENCE DOSE (ARFD)	
		2-6 YEARS	2+ YEARS
MO 0105 Edible offal (mammalian)	0.2	0.3	1.2
PE 0112 Eggs	0.1	0.8	0.3
MM 0095 Meat [mammalian]	0.2	5.5	3.1
ML 0106 Milks	0.1	15.3	5.9
PO 0111 Poultry, edible offal	0.1	0.7	0.7
PM 0110 Poultry meat	0.1	2.4	1.3

Animal commodity MRLs are required to support uses on commodities such as pulses that may be fed to animals and also the use on pastures (generally and red and subterranean clovers). The Australian MRLs were confirmed as appropriate to support the use on pulses for product number 52878 on the basis of animal transfer studies reviewed by the 1998 JMPR and an estimated dietary burden (high residue) of 15 ppm carbendazim.

¹ USDA Fungal Database May 2009

http://nt.ars-grin.gov/fungaldatabases/new_allView.cfm?whichone=FungusHost&thisName=Cercospora%20zebrina&organismtype=Fungus&fromAllCount=yes

Pei You, M (2007) Clover scorch disease of pasture legumes and its control, DAFWA Farmnote 207
http://www.agric.wa.gov.au/content/past/pl/clo/fn2006_cloverscorch_myofu.pdf

Clarke, R (1999) Clover scorch disease of subterranean clover, Vic DPI Agnote AG0725
<http://www.dpi.vic.gov.au/DPI/nreninf.nsf/childdocs/-22C871BE2A0105794A2568B30004D413-F37BCCFCF38BA875CA256BC700824438-058DE7476FF4296C4A256DEA00274F59-53B90EEF2978074CCA256C1900060DC1?open>

Two feeding studies were evaluated by the 1998 JMPR. Dairy cows were fed either carbendazim or benomyl at levels of 2, 10 or 50 ppm in the diet for 4 weeks. Samples of milk collected during the dosing phase and tissues collected at slaughter were analysed for residues of benomyl, carbendazim and metabolites 4-HBC and 5-HBC. No benomyl residues were observed in muscle, liver, kidney or fat of cows that were dosed with benomyl. In the cows dosed with carbendazim, low-level residues of 5-HBC were observed in the liver (0.01 mg/kg) and kidneys (0.06 mg/kg) of cows that were dosed at 50 ppm in the diet. 5-HCB is not included in the Australian residue definition. After 1 week withdrawal from dosing no residues were detectable in any tissue sample.

Low residues of 5-HBC and 4-HBC were present in milk of cows dosed with benomyl or carbendazim at levels higher than 10 ppm in the diet. Residues of the metabolites were undetectable after 2 days withdrawal from dosing. No residues of intact benomyl or carbendazim were reported.

Recommendation: The MRLs for Edible offal (mammalian); meat (mammalian) and Milks remain appropriate.

Other uses

There is a permit current for use on pyrethrum. This is not a food use and therefore will not be considered further.

3.3 Proposed MRL Changes

The following amendments to Table 1 of the MRL Standard are recommended:

Table 1

COMPOUND	FOOD		MRL (MG/KG)
Carbendazim DELETE:	FI 0326	Avocado	3
	FI 0327	Banana	1
	FB 0018	Berries and other small fruits [except grapes]	5
	GC 0080	Cereal grains	*0.05
	FC 0001	Citrus fruits	10
	FI 0332	Custard apple	1
	VC 0045	Fruiting vegetables, Cucurbits [except melons, except Watermelons]	2
	VO 0050	Fruiting vegetables, other than Cucurbits [except mushrooms]	2
	HS 0784	Ginger, root	10
	FB 0269	Grapes	3
	HH 0092	Herbs	T3
		Kaffir lime leaves	T3
		Lemon balm	T3
		Lemon grass	T3
	DT 1111	Lemon verbena	T3
	FI 0343	Litchi	10
	FI 0345	Mango	5
	VC 0046	Melons, except Watermelons	4
	VO 0450	Mushrooms	10
	FI 0350	Papaya	T20
	SO 0697	Peanut	0.2
	TN 0675	Pistachio nut	T0.1
	FP 0009	Pome fruits	5
	FS 0012	Stone fruits	10
	GS 0659	Sugar cane	0.1

COMPOUND	FOOD		MRL (MG/KG)
	HS 0794	Tumeric, root	T3
		Vegetables [except fruiting vegetables, cucurbits; fruiting vegetables, other than cucurbits; mushrooms; pulses]	3

3.3.1 Chronic Dietary Intake

The chronic dietary exposure to carbendazim is estimated by the National Estimated Daily Intake (NEDI) calculation encompassing all registered/temporary uses of the chemical and the mean daily dietary consumption data derived from the 1995 National Nutrition Survey of Australia. The NEDI calculation is made in accordance with WHO Guidelines² and is a conservative estimate of dietary exposure to chemical residues in food. On the basis of carbendazim uses supported by this review the NEDI for carbendazim is equivalent to 4 % of the ADI and is acceptable.

3.4 Conclusions

The Office of Chemical Safety has established an Acute Reference Dose (ARfD) for carbendazim. A number of established uses result in exceedences of the ARfD. The uses can no longer be supported from a residues perspective and the MRLs will be removed from the MRL Standard.

Adequate data are not available to support uses established uses on banana, ginger (seed pieces), mushrooms, onions (seed production), strawberries and sugar cane. The MRLs associated with these uses will be removed from the MRL Standard.

3.5 Recommendations

On the basis of an assessment of registered and permitted carbendazim uses in food production, available residues data and application of the revised acute reference dose, it is recommended that:

1. The following use patterns be deleted on the basis of short-term dietary exposure and the MRL for such uses being inappropriate:
 - Grapes: All uses
 - Citrus fruit: All uses
 - Custard apple and mango: All uses
 - Cucurbits: All uses
 - Pome fruit: All uses
 - Stone fruit: All uses
2. The following use patterns are to be deleted as data are not available to ensure established MRLs are appropriate and that human health is protected. These uses may be subject to a phase out period.

² Guidelines for predicting dietary intake of pesticide residues, WHO, 1997.

- Banana, All uses
 - Strawberries, All uses
 - Mushrooms, All uses³
 - Onions, All uses
 - Ginger, All uses
 - Sugar cane, All uses
 - Pasture, All uses.
3. The following established use patterns are supported by a contemporary risk assessment:
- Pulses (chickpeas, faba beans, lentils and vetch), chocolate spot, grey mould
 - Macadamia nuts: macadamia husk spot
4. The grazing withholding periods for:
- Macadamia plantations should be 4 weeks on all labels including this use
5. MRLs that are no longer associated with a registered or permitted use should be removed from the MRL Standard.

In accordance with the above recommendations, the changes to the MRL Standard noted at 5 (Proposed MRL Changes) will be made. Following implementation of these changes, entries in the MRL Standard for carbendazim will be as follows:

Table 22 proposed entries for carbendazim in the MRL Standard

COMPOUND	FOOD		MRL (MG/KG)
Carbendazim	MO 0105	Edible offal (mammalian)	0.2
	PE 0112	Eggs	*0.1
	TN 0669	Macadamia nuts	0.1
	MM 0095	Meat [mammalian]	0.2
	ML 0106	Milks	*0.1
	PO 0111	Poultry, Edible offal of	*0.1
	PM 0110	Poultry meat	*0.1
	VD 0070	Pulses	0.5

³ At the time of preparation of this report. Carbendazim is used on mushrooms and onions under permit.

Table 23 No change to proposed entries for carbendazim in Table 3 of the MRL Standard

COMPOUND	RESIDUE
Carbendazim	Sum of carbendazim and 2-aminobenzimidazole, expressed as carbendazim

COMPOUND	ANIMAL FEED COMMODITY		MRL (MG/KG)
Carbendazim	AL 0157	Legume animal feeds	25

There are no entries for carbendazim in Table 5 of the MRL Standard.

Appendix 1: Summaries of relevant available data

Berries and other small fruits

Summary of relevant carbendazim residue data for strawberries reported by the 1998 JMPR.

County Report no. Year Location	Application		PHI, days	Sample	Residues, mg/kg	
	No	kg ai/ha				
UK A53868 1972 March, Cams	3		0.045	9	green fruit	1.2 x2
				16		0.9, 1.2
	3		0.036	9		0.9
Italy A53868 1972 Masi Torelo		2.25	0.045	16		0.3
	4			0	fruit	2.5
				1		2.5
				5		2.5
				7		1.8
				14		1.4
21				1.4		
			28		0.6	

Citrus processing

A citrus processing study undertaken in the USA with Benomyl was evaluated by the 1998 JMPR. A foliar application was made at more than 7x GAP (USA GAP reported as 1-2 app of 0.84-1.68 kg ai/ha, 2 day PHI) followed by dipping in a solution containing 240 g benomyl/hl. Residues of benomyl, carbendazim and 2-aminobenzimidazole (2-AB) were determined and reported as carbendazim.

Sample	PHI (days)	Residues as carbendazim (mg/kg)	Processing factor
Unwashed fruit	0	6	1
washed fruit	0	0.74	0.12
juice	0	0.1	0.016
finisher pulp	0	0.07	0.012
oil emulsion water	0	0.93	0.15
press liquor	0	1	0.16
peel frits	0	2.6	0.43
orange oil	0	8.2	1.36
chopped peel	0	1.5	0.25
dried peel	0	5.3	0.88
molasses	0	3.6	0.6

Processing factors into juice of 0.23 – 0.83 were also reported for studies undertaken in Brazil following foliar application only.

The 1998 JMPR reported that metabolism of benomyl to carbendazim in/on orange peel is not complete, with 61% of the total carbendazim residue being present as benomyl after 15-16 days. Thus there are some uncertainties in applying benomyl processing studies to estimation of residues arising from carbendazim use.

Tropical fruits, inedible peel

Custard apple

Residues of carbendazim in custard apples were reported in the evaluation of Permit 4510 as follows:

Trial, location, State, year, variety	Rate of application (g ai/hL)	Number of applications	Days after treatment	Carbendazim (mg/kg)
Nambour, Qld	25	3	0	0.60
			3	0.52
			7	0.59*
		4	0	0.91
			3	0.81
			7	0.85*
Woombyne, Qld	25	3	0	0.68
			3	0.56
			7	0.48
		4	0	0.98
			3	0.67
			7	0.56 (0.54)

LOD = 0.01 mg/kg, LOQ = 0.05 mg/kg

Mango - post harvest dip

Residues of carbendazim and 2-aminobenzimidazole (2-AB) in mangoes following supervised post-harvest dipping for 5 minutes at 52°C in Australia are summarised below (only relevant data presented).

	Application			Residue (mg/kg)		
		kg ai/hl	part	MBC	2-AB	whole fruit
Collinsville QLD 2001 cv Keitt	SC	0.05	skin+flesh	3.3	<0.01	3.0
Mapee QLD 201 cv Keitt	SC	0.05	flesh	1.7	<0.01	3.1
Northey QLD 2002 cv Keitt	SC	0.05	flesh	0.21	<0.02	1.6
Northey QLD 2002 cv Palmer	SC	0.05	flesh	0.29	<0.02	1.2
Speewah QLD 2003 cv Kensington Pride	SC	0.05	flesh	0.5	0.28	1.3
Kollinsville QLD 2003 cv Kensington Pride	SC	0.05	flesh	0.4	0.11	1.9

whole fruit - does not include 2-AB

Pome fruit

Results of residue trials summarised in the 1998 JMPR.

Source	Rate kg/hl	# apps	PHI	Residue (mg/kg)
JMPR 1998 Carbendazim - Germany A39727 1996	SC 0.0288	3	0	0.79
			7	0.49
			14	0.50
			56	0.82
			98	0.48
			140	0.39
			182	0.58
JMPR 1998 Carbendazim - Germany A39728 1996	SC 0.0288	3	0	0.70
			7	0.90
			14	0.28

Source	Rate		PHI	Residue (mg/kg)
	kg/ha	# apps		
			56	0.6
			98	0.69
			140	0.53
			182	0.67
JMPR 1998 Carbendazim - Germany A39729 1986	SC 0.0288	3	0	0.31
			7	<u>0.36</u>
			14	0.26
			56	0.18
			98	0.29
			140	0.17
			182	0.22
JMPR 1998 Carbendazim - Germany A39730 1986	SC 0.0288	3	0	0.86
			7	<u>0.70</u>
			14	0.71
			56	0.56
			98	0.51
			140	0.66
			182	0.37
JMPR 1998 Carbendazim - Germany A39723 1987	SC 0.0288	3	0	0.28
			7	<u>0.30</u>
			14	0.18
			56	0.26
			98	0.28
			140	0.23
			182	0.23
JMPR 1998 Carbendazim - Germany A39724 1987	SC 0.0288	3	0	0.51
			7	<u>0.84</u>
			14	0.16
			56	0.30
			98	0.22
			140	0.35
			182	0.34
JMPR 1998 Carbendazim - Germany A39725 1987	SC 0.0288	3	0	0.93
			7	<u>0.42</u>
			14	0.33
			56	0.17
			98	0.24
			140	0.21
			182	0.17
JMPR 1998 Carbendazim - Germany A39726 1987	SC 0.0288	3	0	0.41
			7	<u>0.35</u>
			14	0.20
			56	0.24
			98	0.25
			140	0.23
			182	0.18

The 1994 JMPR provided a very brief summary of 23 trials on apples in Germany. The HR observed at a 5 day PHI was 2.5 mg/kg. Application rates were not specified. The German GAP of the time was 0.374 kg ai/ha.

Cucurbits

Results of residue trials summarised in the 1998 JMPR.

County Report no. Year Location	Application			PHI, days	Sample	Residues, mg/kg
	No	kg ai/ha	kg ai/ha			
Trials undertaken with Benomyl, results as carbendazim						
Canada TAS000-005 1969	4	0.28	0.03	0	cucumber	<u>0.34</u>
				7		0.17
				14		0.08
1969 Veitshochheim Greece AMR 3427- 95 1995 Attica	4	0.56	0.06	0	cucumber	<u>0.36</u>
				7		0.24
				3		<u>0.1</u>
Spain AMR 3427-95 1995 Huesca	3	0.228-0.239	0.03	0	cucumber	0.06
				1		<0.03
				3		<u><0.03</u>
				5		<0.03
				7		<0.03
USA TAS000-005 1967 CA	3	0.231-0.240	0.03	0	cucumber	<0.03
				1		<0.03
				3		<u><0.03</u>
				5		<0.03
				7		<0.03
USA TAS000-005 1967 CA	4	0.42	0.03	0	cucumber	<u>0.23</u>
				9		<0.03
				3		<u><0.03</u>
1968 TX	2	0.28	0.03	3	cucumber	<u><0.03</u>
TX	2	0.44	0.03	3	cucumber	<u>0.08</u>
USA TAS000-005 1967 CA	4	0.42	0.03	0	Summer squash	<u>0.36</u>
				7	<0.03	
FL	5	0.84	0.03	1	Summer squash	<u>0.32</u>
				5	0.11	
TX	2	0.7	0.03	3	Summer squash	<u>0.11</u>
TX	3	0.7	0.03	3		<u>0.06</u>
Canada TAS000-005 1969	7	0.14	0.03	0	melons	<u>0.18</u>
France BEA118908- BG Tarn 1988	4	0.37	0.3	3	melons	<u>0.1</u>

County Report no. Year Location	Application			PHI, days	Sample	Residues, mg/kg
	No	kg ai/ha	kg ai/hl			
				7		<0.05
				14		<0.05
	4	0.39	0.03	3	melons	<u>0.33</u>
				7		0.19
				14		0.08
USA TAS000-005 1967 CA	4	0.28		0	melons	0.08
				7		<0.03
AZ 1968	7	0.28		3	melons	<u><0.03</u>
TX	2	0.28		3	melons	<u><0.03</u>
	2	0.45		3	melons	<u>0.07</u>
				7		0.05
USA TAS000-005 1967 SC	7	0.42		1	watermelons	<u>0.18</u>
				7		<0.06
	7	0.21		1	watermelons	<u><0.06</u>
				7		<0.06
	7	0.42		1	watermelons	<u>0.09</u>
				7		0.12
	4	0.42		1	watermelons	<u>0.09</u>
				7		0.09
Trials undertaken with Carbendazim						
Germany A3865 1971 Haettersheim	1	0.36	0.06	0	gherkins	<0.05
				3		<u><0.05</u>
				7		<0.05
				14		<0.05
				21		<0.05
				28		<0.05
	1	0.27	0.45	0	gherkins	<0.05
				3		<u><0.05</u>
				7		<0.05
				14		<0.05
				21		<0.05
				28		<0.05
	2	0.27	0.45	0	gherkins	<0.05
				3		<u><0.05</u>
				7		<0.05
				14		<0.05
				21		<0.05
				28		<0.05
	1	0.36	0.06	0	gherkins	<0.05
				3		<u><0.05</u>
				7		<0.05
				14		<0.05
				21		<0.05
				28		<0.05

County Report no. Year Location	Application			PHI, days	Sample	Residues, mg/kg
	No	kg ai/ha	kg ai/hl			
				28		<0.05
	2	0.27	0.045	0	gherkins	<0.05
				3		<u><0.05</u>
				7		<0.05
				14		<0.05
				21		<0.05
				28		<0.05
	2	0.36	0.06	0	gherkins	<0.05
				3		<u><0.05</u>
				7		<0.05
				14		<0.05
				21		<0.05
				28		<0.05

Appendices 2 and 3: Commercial In Confidence data - not included in this edition of the report.