APPENDIX 2:

Metabolism

There were many volumes of metabolism data submitted but there were no issues concerning the residues definition or other matters pertaining to metabolism, so no review was undertaken of the submitted data. For reference, the JMPR report on Fenthion in 1995 accurately summarised the metabolism of fenthion for the interested reader.

Magnitude of residues in crops, livestock and processed commodities

Residue data supplied by Bayer or previously available to the APVMA

Citrus fruit

Ref. 217: Residue trials with Lebaycid 50% EC on oranges in Spain. Anonymous (1970). Bayer AG Report no. 0328-69.

Ref. 218: Residue trials with Lebaycid 50% EC on oranges in Spain. Anonymous (1970). Bayer AG Report no. 0357-69.

Ref. 219: Residue trials with Lebaycid 500 EC on oranges in Spain. Anonymous (1991). Bayer AG Report no. 0496-90.

Ref. 236: Determination of residues of Lebaycid 500 EC on orange in Spain. Ohs P (1996). Bayer AG Report no. RA-2097/94.

Ref. 239: Determination of residues of Lebaycid 500 EC in/on orange and mandarin under actual use conditions in Spain. Ohs P & Walz-Tylla B (1994). Bayer AG Report no. RA-2101/92.

Ref. 220: Residue trials with Lebaycid 50% EC on mandarin oranges in Spain. Anonymous (1970). Bayer AG Report no. 0329-69.

Ref. 221: Residue trials with Lebaycid 50% EC on mandarin oranges in Spain. Anonymous (1969). Bayer AG Report no. 0360-69.

Ref. 222: Residue trials with Lebaycid 500 EC on mandarin oranges in Spain. Anonymous (1982). Bayer Report no. 5000-81.

Ref. 237: Determination of residues of Lebaycid 500 EC on mandarin in Spain. Ohs P (1996). Bayer AG Report no. RA-2119/94.

Residue results are summarised in Table A2.1. Residues measured were fenthion, fenoxon and their sulfoxides and sulfones, and are expressed as fenthion.

Table A2.1: Residues of fenthion in whole fruit, peel and pulp following treatment and sampling of citrus fruit in Spain

CROP	DATES	FORM	NO. OF APPLIC^{N}S (INTERVAL)	RATE (g ai/ha)	VOLUME (L/ha)	PHI (DAYS)	RESIDUES OF FENTHION (mg/kg) FRUIT	PEEL	PULP	REFS
Orange	1969	50 EC	1	150	20	0	< 0.1	0.20		217
						7	< 0.1	0.15		
						14	< 0.1	0.20		
	1969	50 EC	1	150	20	0	0.04	0.12		218
						7	0.06	0.13		
						14	0.025	0.07		
						28	0.02	0.05		
	1991	500 EC	1	52.5	*7	0	< 0.01, 0.03	< 0.01, 0.13	< 0.01, < 0.01	219
						14	< 0.01, < 0.01	< 0.01, 0.02	< 0.01, < 0.01	
	1996	500 EC	1	52.5	*7	0	0.23, 0.01	0.78, < 0.05	< 0.01, < 0.01	236
						3	0.02, 0.01	0.06, < 0.05	< 0.01, < 0.01	
						7	0.15, 0.01	0.58, < 0.05	< 0.01, < 0.01	
						14	0.01, 0.02	< 0.05, 0.09	< 0.01, < 0.01	
	1994	500 EC	1	52.5	*7	0	0.75, 0.98, 0.09	2.8, 3.4, 0.27	< 0.01, < 0.01, < 0.01	239
						3	0.18, 0.15, 0.05	0.69, 0.56, 0.14	< 0.01, < 0.01, < 0.01	
						14	0.10, 0.11, 0.04	0.34, 0.34, 0.12	< 0.01, < 0.01, < 0.01	

CROP	DATES	FORM	NO. OF APPLICNS (INTERVAL)	RATE (g ai/ha)	VOLUME (L/ha)	PHI (DAYS)	RESIDUES OF FENTHION (mg/kg) FRUIT	PEEL	PULP	REFS
Mandarin	1969	500 EC	1	150	20	0	< 0.1	0.25		220
						7	< 0.1	< 0.1		
						14	< 0.1	< 0.1		
	1969	500 EC	1	150	20	0	0.25	0.73		221
						7	0.22	0.60		
						14	0.13	0.29		
						28	0.08	0.20		
	1981	500 EC	1	375	20	0	0.39	1.31	< 0.02	222
						14	0.41	1.42	< 0.02	
						21	0.26	0.9	< 0.02	
						28	0.13	0.48	< 0.02	
						35	0.10	0.31	< 0.02	
	1996	500 EC	1	52.5	*7	0	0.04, 0.04	0.14, 0.19	< 0.01, < 0.01	237
						3	0.03, 0.08	0.08, 0.32	< 0.01, < 0.01	
						7	< 0.01, 0.03	< 0.05, 0.12	< 0.01, < 0.01	
						14	0.01, 0.02	<0.05, 0.05	<0.01, <0.01	
	1994	500 EC	1	52.5	*7	0	0.02, 0.09, 0.03	0.07, 0.38, 0.10	< 0.01, < 0.01, < 0.01	239
						3	0.02, 0.04, 0.04	0.08, 0.20, 0.18	< 0.01, < 0.01, < 0.01	
						14	0.02, 0.21, < 0.01	0.11, 1.0, 0.02	<0.01, <0.01, < 0.01	

Note: * indicates aerial spraying.

Note also that results for whole fruit for references 237 and 236 were calculated from residues occurring in or on peel and pulp.

None of the above treatment regimens match the current Australian GAP of 75 mL/hL water and they are all low-volume treatments applied by aerial application.

Stone fruit

Ref. 211: Residue trials with Lebaycid 50% EC on cherries in Germany. Anonymous (1968). Bayer Report no. 0089-68.

Ref. 212: Residue trials with Lebaycid 50% EC on cherries in Germany. Anonymous (1970). Bayer Report no. 235-69.

Ref. 213: Residue trials with Lebaycid 550 EC on cherries in Germany. Anonymous (1978). Bayer Report no. 5000-78.

Ref. 214: Residue trials with Lebaycid 550 EC on cherries in Germany. Anonymous (1980). Bayer Report no. 5000-79.

Ref. 215: Residue trials with Lebaycid 500 EC on peaches in South Africa. Anonymous (1986). Bayer SA Report no. 311/88946/C194.

Ref. 216: Residue trials with Lebaycid 500 EC on peaches in Spain. Anonymous (1991). Bayer Report no. 0342-90.

Ref. 226: Determination of Lebaycid 550 EC and 100 EW residues in cv Jersey Queen peaches following a schedule of sprays. Birley TA (1997). Bayer Australia Report no. TAB 199/97.

Ref. 232: Determination of residues of Lebaycid 500 EC on peach following spray application in Spain. Heinemann O & Ohs P (1996). Bayer AG Report no. RA-2098/94.

Ref. 235: Determination of residues of Lebaycid500 EC in/on peaches under actual use conditions in Spain. Ohs P (1994). Bayer AG Report no. RA-2081/93.

Ref. 247: Determination of fenthion residues in peaches, Stanthorpe, Queensland. Radunz LA (1991). Bayer Australia Report no. LAR 196/91.

Ref. 248: Determination of fenthion residues in plums, Stanthorpe, Queensland. Radunz LA (1991). Bayer Australia Report no. LAR 195/91.

Ref. 225: Determination of Lebaycid 550 EC and 100 EW residues in cv Le Grand nectarines following a schedule of sprays. Birley TA (1997). Bayer Australia Report no. TAB 200/97.

Ref. 249: Determination of fenthion residues in nectarines, Stanthorpe, Queensland. Radunz LA (1991). Bayer Australia Report no. LAR 197/91.

Residue results are summarised in Table A2.2. Residues measured were fenthion, fenoxon and their sulfoxides and sulfones, and are expressed as fenthion.

Table A2.2: Residues of fenthion in whole fruit following treatment and sampling of stone fruit in Australia, Europe and South Africa

CROP	LOCATION	DATES	FORM	NO. OF APPLIC^{N}S (INTERVAL)	RATE (g ai/100 L)	VOLUME (L/ha)	PHI (DAYS)	RESIDUES OF FENTHION (mg/kg)	REFS
Cherry	Germany	1968	500 EC	1	50	?	0	4.6, 4.75, 5.05, 5.4	211
							7	0.65, 0.95, 0.95, 1.25	
							9, 10	0.5, 0.3, 0.55, 0.9	
							14	0.5, 0.55, 1.0, 0.6	
	Germany	1969	500 EC	1	25, 50	?	1	2.4, 4.8	212
							8	0.8, 0.6	
							14	0.35, 0.8	
	Germany	1978	550 EC	1	55, 110	2000/1000	0	4.2, 4.0, 5.6	213
							4	1.8, 1.4, 4.1	
							7	0.99, 0.66, 1.0	
							14	0.32, 0.65, 1.1	
							21	0.38, 0.35, 0.47	
	Germany	1979	550 EC	1	55	1500	0	0.03	214
							5	0.02	
							8	< 0.01	
							15	< 0.01	
							21	< 0.01	
Peach	South Africa	1986	500 EC	1	62.5	3000	0	4.75	215
							7	2.1	
							14	1.1	
							21	0.435	
							29	0.225	
							35	0.105	
	Spain	1990	500 EC	2 (14d)	100	1000	0	2.0, 1.7	216
							20	0.58, 0.48	

CROP	LOCATION	DATES	FORM	NO. OF APPLIC^{N}S (INTERVAL)	RATE (g ai/100 L)	VOLUME (L/ha)	PHI (DAYS)	RESIDUES OF FENTHION (mg/kg)	REFS
Peach	Australia	1997	550 EC *or* 100 EW	5 (7d)	40, 41	1.8 L/tree	0	2.11, 1.81	226
							3	1.39, 1.41	
							7	0.74, 0.57	
							14	0.39, 1.46	
					80, 82.5	1.8 L/tree	0	2.61, 1.81	
							3	2.92, 1.87	
							7	1.62, 2.22	
							14	1.84, 0.91	
	Spain	1994	500 EC	2 (20d)	75	1500	0	1.2, 1.8	232
							7	0.9	
							15	0.49	
							21	0.19	
							28	0.18, 0.18	
		1993	500 EC	2 (21d)	75	1500	0	0.99, 2.3	235
							10	0.2	
							14	0.16	
							21	0.08	
							28	0.05, 0.13	
	Australia	1991	550 EC	5 (7d)	41	400	0	2.9	247
							1	3.0	
							3	2.3	
							4	2.3	
							7	3.8	
					82	400	0	11.0	
							1	7.9	
							3	6.8	
							4	6.7	
							7	1.7	

CROP	LOCATION	DATES	FORM	NO. OF APPLIC^{N}S (INTERVAL)	RATE (g ai/100 L)	VOLUME (L/ha)	PHI (DAYS)	RESIDUES OF FENTHION (mg/kg)	REFS
Plum	Australia	1990	550 EC	5 (7d)	41	400	0	1.7	248
							1	2.6	
							3	1.1	
							4	1.3	
							7	1.2	
					82	400	0	3.6	
							1	2.9	
							3	2.8	
							4	2.4	
							7	1.7	
Nectarine	Australia	1995	550 EC	5 (7d)	40/41	1.8 L/tree	0	0.76, 0.51	225
							3	0.33, 0.50	
							7	0.21, 0.37	
							14	0.14, 0.11	
					80/82	1.8 L/tree	0	1.17, 1.27	
							3	0.58, 0.81	
							7	0.15, 0.33	
							14	0.33, 0.76	
	Australia	1991	550 EC	5 (7d)	41	400	0	1.2	249
							1	1.4	
							3	0.6	
							4	0.4	
							7	0.5	
					82	400	0	2.8	
							1	2.1	
							3	1.8	
							4	1.3	
							7	1.2	

The Australian GAP is for three treatments at 7-day intervals for stone fruit (not low-chill varieties) at a concentration of 41 g ai/hL, with the final treatment being 2 weeks before picking begins. Low-chill varieties have five treatments at 7-day intervals, with the final treatment being 7 days before the expected harvest date. Only some of the trial data approximate this GAP, namely references 211, 212, 213, 214, 225, 226, 247, 248 and 249 so only these data will be used in the assessment of an MRL, except the data for Reference 214, which are unexplainably low and can be rejected as an outlier. Maximum residue at 7 days is 1.25 mg/kg in cherries, 3.8 mg/kg in peaches, 1.2 mg/kg in a single plum sample and 0.5 mg/kg in nectarines. At 14 days the maximum residue is 1.1 mg/kg in cherries, 1.46 mg/kg in peaches, 0.14 mg/kg in nectarines, and there were no plum samples at that time.

Blueberries

Ref. 250: Determination of fenthion residues in blueberries, Corindi Beach. Radunz LA (1992). Bayer Report no. LAR 184/91.

The data from this one trial are summarised in Table A2.3. Residues measured were fenthion, fenoxon and their sulfoxides and sulfones, and are expressed as fenthion.

Table A2.3: Residues of fenthion in whole fruit following treatment and sampling of blueberries in Australia

CROP	LOCATION	DATES	FORM	NO. OF APPLIC^{N}S (INTERVAL)	RATE (g ai/100 L)	VOLUME (L/ha)	PHI (DAYS)	RESIDUES OF FENTHION (mg/kg)	REF.
Blueberry	Australia	1990	550 EC	3 (33d)	41	2000	7	12.1	250
					82	2000	7	8.5	

This single trial showed maximum residues at 7 days at 12.1 mg/kg in blueberries. However, no use on blueberries is approved or permitted, either pre- or post-harvest.

Olives

Ref. 157: Persistence and fate of fenthion in olives and olive products. Cabras P, Garau VL, Melis M, Pirisi FM & Spanedda L (1993). Journal of Agricultural and Food Chemistry 41(12):2431–2433.

Ref. 164: Persistence of fenthion residues in olive oil. Lentza-Rizos C, Avramides EJ & Roberts RA (1994). Pesticide Science 40(1):63–69.

Ref.: Decay of fenthion in green table olives. Rotunno T, Di Caterina R & Argenti L (1997). Journal of Agricultural and Food Chemistry 45(10):3957–3960.

Residue results are summarised in Table A2.4. Residues measured were fenthion, fenoxon and their sulfoxides and sulfones, and are expressed as fenthion.

Table A2.4: Mean residues of fenthion in olives following treatment of olive trees in Italy

CROP	LOCATION	DATES	FORM	NO. OF APPLIC^{N}S (INTERVAL)	RATE (g ai/100 L)	VOLUME (L/ha)	PHI (DAYS)	RESIDUES OF FENTHION (mg/kg)	REF.
Olives	Italy	1991	25% EC	5 (9–23 days)	200	?	0	3.23	157
							11	2.86	
							20	2.96	
							34	2.57	
							54	1.78	
			25% EC	3 (8–38 days)	200	?	0	1.98	
							11	1.25	
							20	1.18	
							34	0.99	
							54	0.66	

The results above are the sum of the means of fenthion and each metabolite, the individual results not being recorded. Neither of the other two references had data that could be used to assist in determining the numerical value of any MRL.

Tropical fruit

Ref.: Fenthion residues in tropical fruit. Smith KJ (1989). NSW Agriculture and Fisheries report.

No data were submitted for the review. The APVMA supplied this reference from its archives. The results include only fenthion residues and do not include any determination of the other metabolites. Data were generated for low-chill peaches, avocados, mangoes, kiwifruit, persimmons and custard apples. Results are shown in Table A2.5. All trials were conducted at both 41 and 82 g ai/hL, with 4–5 sprays, with the final sprays being 7 days apart.

Table A2.5: Fenthion residues in tropical and sub-tropical fruits

FRUIT	APPLICATION RATE (g/100 L)	DAYS AFTER LAST SPRAY							
		0	1	3	4	5	7	14	16
Mango	41	0.61	0.45	0.36	-	0.36	0.30	-	-
	82	0.81	0.51	0.83	-	0.55	0.53	-	-
Peach	41	3.18	3.05	1.27	-	1.03	1.08	0.33	-
	82	7.36	5.75	2.77	-	3.36	1.54	0.12	-

FRUIT	APPLICATION RATE (g/100 L)	DAYS AFTER LAST SPRAY 0	1	3	4	5	7	14	16
Persimmon	41	2.28	0.46	0.36	-	0.24	0.36	0.06	-
	82	1.13	1.12	0.55	-	0.16	0.13	0.03	-
Kiwifruit	41	5.51	4.60	2.61	-	1.96	1.51	-	0.56
	82	13.74	10.77	5.37	-	3.99	3.29	-	1.29
Avocado	41	0.31	0.25	0.04	-	0.01	0.01	< 0.01	-
	82	0.53	0.21	0.01	-	0.01	0.01	< 0.01	-
Custard apple	41	1.16	0.67	0.43	0.50	-	0.15	0.07	-
	82	0.80	1.00	0.95	0.74	-	0.23	0.10	-

Apart from the metabolites not being determined, there was no replication of these trials. The data recorded above do not allow the true variability of residues for any particular fruit to be measured or even estimated. In many samples, the higher application rate has a lower residue than the lesser application rate. There were also no data that determined the distribution of residues within the fruits of those with inedible peel.

Tomatoes (post-harvest)

Ref.: Dimethoate and fenthion as packing line treatments for tomatoes against *Dacus tryoni*. Heather NW, Hargraves PA, Corcoran RJ & Melksham KJ (1987). Australian Journal of Experimental Agriculture 27(3):465–469.

No data were submitted for the review, and the above reference was obtained from the APVMA archives. The above reference contained data that included only the parent compound and not any metabolites, so the data are limited in their use to determine the influence of post-harvest treatments on the magnitude of any MRL. A summary of the data is shown in Table A2.6.

Table A2.6: Fenthion residues in tomatoes following post-harvest dipping at 400 mg/L

CROP	LOCATION	DATES	FORM	NO. OF APPLIC^{N}S	RATE (mg ai/L)	DAT (DAYS)	RESIDUES OF FENTHION (mg/kg)*
Tomato	Australia	1987	?	1 (dipping)	400	0	1.2, 1.3
						3	0.83, 1.1
						7	0.58, 1.1

Note: * Residue is for parent only—metabolites were not determined.

Residues in other commodities show significant levels of some metabolites in the commodity, so the results shown here for tomatoes are of limited value without the metabolites being included.

Residues in processed commodities

Ref. 223: Processing study on apples. Anonymous (1991). Bayer Report no. 0644-90.

There were also studies reported on the processing of citrus and the information and data are shown in the section on citrus. The summary of data from the above study on apples is shown in Table A2.7.

Table A2.7: Residues of fenthion in apple processing products following treatment in Spain in 1990

CROP	DATES	FORM	NO. OF APPLIC^{N}S (INTERVAL)	RATE (g ai/HL)	VOLUME (L/ha)	PHI (DAYS)	SAMPLE	RESIDUES OF FENTHION (mg/kg)	REF.
Apple	1990	500 EC	2 (14d)	100	1000	0	Fruit	0.97	223
						18	Fruit	0.22	
						18	Apple juice—crude	0.20	
						18	Sauce	0.11	
						18	Juice	0.18	
						18	Washings	< 0.01	
						18	Washed apples	0.12	
						18	Apple pomace	0.96	

The apple data indicate that the highest residue to occur in pomace from apples containing 0.22 mg/kg was 0.96 mg/kg, a concentration factor of 4.36. The maximum residue in orange peel coming from oranges with a whole-fruit residue of 0.18 mg/kg was 0.56 mg/kg (at an application rate of 52.5 g ai/100 L), 3 days after treatment (refer Table A2.1). The concentration factor for oranges from whole fruit to peel ranged from 3.0 to 3.9, with a mean of 3.4. The highest residue in mandarins treated at an appropriate rate was 0.21 mg/kg giving a residue in peel of 1.0 mg/kg (refer Table A2.1). The concentration factor for mandarin skin ranged from 2.2 to 5.0, with a mean of 3.5. An appropriate MRL in citrus peel would be 2 mg/kg fenthion.

Orange juice contained no detectable residues when produced from oranges containing residues at 0.18 and 0.15 mg/kg.

Residues in animal tissues and milk following oral dosing

Ref. 209: Bovine residue feeding study: fenthion residues in cattle tissues. Chemagro (1965). Chemagro Report no. 16551.

Ref. 30: Response from cows fed diets containing fenthion or fenitrothion. Johnson JC Jnr & Bowman MC (1972). Journal of Dairy Science 55(6):777–782.

Ref. 244: A 28-day feeding study of fenthion in dairy cattle. Phillips JD, Roesel LL, Chickering CD & Gronberg RR (1966). Bayer Report no. 107313.

Ref. 210: Bovine residue feeding study: fenthion residues in (residue form) cattle milk. Chemagro (1966). Chemagro Report no. 18067.

Residues data from trials where cattle were fed fenthion in their diets are summarised in Table A2.8.

Table A2.8: Fenthion residues in milk and tissues from cattle and cows fed fenthion in their diets at varying rates

YEAR	LOCATION	RATE	NO. OF DAYS FED	NO. ANIMALS	WEIGHT RANGE (kg)	SAMPLING TIME (DAYS)	TISSUE	RESIDUES (mg/kg)	REFS
1965	USA	2.5 mg/kg bw/day	6	3	360–450	1 (post-feeding)	Meat, liver, kidney, fats	< 0.1	209
						3	Meat, liver, kidney, fats	< 0.1	
1972	USA	25 ppm	28	2	?	7	Milk	0.010	30
						14		0.012	
						21		0.014	
						28		0.018	
		50 ppm	28	2	?	7	Milk	0.043	
						14		0.033	
						21		0.041	
						28		0.049	
		100 ppm	28	2	?	7	Milk	0.078	
						14		0.074	
						21		0.086	
						28		0.099	
1995	USA	0.075 mg/kg bw/day	28	3	535–554	28	Milk	< 0.01	244
		0.225 mg/kg bw/day	28	3	599–611	28	Milk	< 0.01	
						28	Liver	< 0.05, < 0.05, < 0.05	
						28	Kidney	NA	
						28	Muscle	NA	
						28	Fat	< 0.05, < 0.05, < 0.05	

YEAR	LOCATION	RATE	NO. OF DAYS FED	NO. ANIMALS	WEIGHT RANGE (kg)	SAMPLING TIME (DAYS)	TISSUE	RESIDUES (mg/kg)	REFS
		0.75 mg/kg bw/day	28	3	508–529	1	Milk	0.020	
						7		0.039	
						14		0.030	
						21		0.040	
						28		0.041	
						28	Liver	< 0.05, < 0.05, 0.07	
						28	Kidney	All < 0.05	
						28	Muscle	All < 0.05	
						28	Fat	<0.05, 0.10, 0.12	

No data were presented for poultry or pigs, and this is seen as a deficiency in the knowledge of the fate of fenthion residues when consumed by animals. There were also no metabolism data available to the reviewer for poultry that could give some indication of the relative metabolism of fenthion in cattle and poultry. However, the feeding of apple pomace and citrus peel (the only two commodities that could be considered as animal feeds) to poultry is not considered a normal practice, so that this lack of data is not critical to the setting of feed MRLs.

Residues of fenthion, its sulfoxide and sulfone, and the sulfone of the oxygen analogue were found in all milk samples in the data from Reference 30. No residues of the oxygen analogue or its sulfoxide were found in milk. Differentiation of residues was not reported in the tissues samples.

Note: Maximum feeding level is determined for a 500 kg bovine consuming 20 kg dry matter when dosed at the maximum level indicated in Table A2.8 where no residues occur in the tissues and milk. In this instance it is 0.225 mg/kg bw, which is equivalent to 0.225 x 500/20 ppm in the diet.

At feeding levels up to 5.6 ppm, no residues would occur in the tissues and milk of cattle.

Residue data supplied by HAL in 2010

Study number 07-HAL-005(a)GLP; Determination of residues of the active constituents: dimethoate, omethoate and fenthion, in various fruit and vegetable crops following pre-harvest applications using the formulated products, Danadim Insecticide, Nufarm Dimethoate Systemic Insecticide and Lebaycid® Insecticide Spray; **Volume 2: Stone fruit; Part b: Fenthion.**

The study was conducted to determine residues of fenthion in stone fruit (peaches, nectarines and cherries) following pre-harvest applications of Lebaycid® Insecticide Spray, containing 550 g/L fenthion. The trials

were located in Victoria and Queensland. Lebaycid® Insecticide Spray was applied to the point of run-off at the target concentration of 75 mL/100 L (41.25 g ai/100 L). Each crop was treated with either 1, 3 or 5 applications, with the last application approximately 7 days before harvest. The interval between applications was 7 to 14 days. Samples of whole fruit were collected between 0 and 21 days after the final application. Samples were stored frozen until analysis, which was within 9 months.

Samples were analysed for residues of fenthion and metabolites fenthion-sulfoxide, fenthion-sulfone, oxon, oxon-sulfoxide and oxon-sulfone. Samples were homogenised and extracted into organic solvent using sonication. The solvent was evaporated and the aqueous residue partitioned against dichloromethane. The dichloromethane extracts were combined and evaporated before redissolving in acetone. An aliquot was filtered before analysis by GC-MS. Recoveries of fenthion and its metabolites from fortified control samples of peaches, nectarines and cherries were within acceptable limits as summarised in Table A2.9. Residues found in treated samples are summarised in Table A2.10.

Table A2.9: Recoveries of fenthion and metabolites from fortified control samples of stone fruit

ANALYTE	CROP	FORTIFICATION RANGE	AVERAGE RECOVERY	COEFFICIENT OF VARIATION
Fenthion	Peach	0.01–5.0 mg/kg as fenthion	90.8%, n = 8	10.6%
	Nectarine	0.01–5.0 mg/kg as fenthion	88.8%, n = 10	10.0%
	Cherry	0.01–5.0 mg/kg as fenthion	86.5%, n = 10	9.8%
Fenthion-sulfone	Peach	0.01–5.0 mg/kg as fenthion-sulfone	86.6%, n = 8	9.7%
	Nectarine	0.01–5.0 mg/kg as fenthion-sulfone	92.2%, n = 10	6.9%
	Cherry	0.01–5.0 mg/kg as fenthion-sulfone	92.7%, n = 10	9.1%
Fenthion-sulfoxide	Peach	0.01–5.0 mg/kg as fenthion-sulfoxide	88.6%, n = 8	9.8%
	Nectarine	0.01–5.0 mg/kg as fenthion-sulfoxide	86.9%, n = 10	10.6%
	Cherry	0.01–5.0 mg/kg as fenthion-sulfoxide	84.8%, n = 10	8.8%
Fenthion-oxon	Peach	0.01–5.0 mg/kg as fenthion-oxon	93.0%, n = 8	7.8%
	Nectarine	0.01–5.0 mg/kg as fenthion-oxon	88.8%, n = 10	12.0%
	Cherry	0.01–5.0 mg/kg as fenthion-oxon	89.4%, n = 10	10.0%
Fenthion-oxon-sulfone	Peach	0.01–5.0 mg/kg as fenthion-oxon-sulfone	85.9%, n = 8	11.8%
	Nectarine	0.01–5.0 mg/kg as fenthion-oxon-sulfone	88.3%, n = 10	9.5%
	Cherry	0.01–5.0 mg/kg as fenthion-oxon-sulfone	91.6%, n = 10	9.8%

ANALYTE	CROP	FORTIFICATION RANGE	AVERAGE RECOVERY	COEFFICIENT OF VARIATION
Fenthion-oxon-sulfoxide	Peach	0.01–5.0 mg/kg as fenthion-oxon-sulfoxide	91.6%, n = 8	10.4%
	Nectarine	0.01–5.0 mg/kg as fenthion-oxon-sulfoxide	88.6%, n = 10	8.3%
	Cherry	0.01–5.0 mg/kg as fenthion-oxon-sulfoxide	88.3%, n = 10	10.2%

Table A2.10: Residues of fenthion in stone fruit following pre-harvest treatment

CROP, VARIETY, LOCATION, YEAR	APPLICATION RATE (g ai/ha)	NO. OF APPLIC^{N}S, INTERVAL (DAYS)	WATER VOLUME FOR FOLIAR APPLIC^{N}S (L/ha)	SAMPLE	DAYS AFTER LAST TREATMENT	FENTHION RESIDUE (mg/kg)
Peach ('Canning'), Toolambah, Vic., 2008	UTC	–	–	Whole fruit	–	< LOQ
	292, 273, 289, 292, 305	5 (13, 8, 6, 8)	707, 662, 700, 707, 740	Whole fruit	0 3 5 7	3.15 2.29 1.73 1.25
Peach ('Rich Lady'), Cottonvale, Qld, 2008	UTC	–	–	Whole fruit	–	< LOQ
	215, 225, 219	3 (11, 4)	520, 545, 530	Whole fruit	0 7 14 21	2.24 0.97 0.31 0.16
	212	1	515	Whole fruit	3 7	1.02 0.57
Nectarine ('White Flesh'), Tyabb, Vic., 2008	UTC	–	–	Whole fruit	–	< LOQ
	283, 327, 327, 327, 323	5 (14, 5, 10, 6)	686, 792, 792, 792, 784	Whole fruit	0 3 5 7	2.24 1.52 1.03 0.87
Nectarine ('Rose Bright'), Cottonvale, Qld, 2008	UTC	–	–	Whole fruit	–	< LOQ
	107, 215, 208	3 (11, 4)	260, 520, 505	Whole fruit		No results recorded for these samples due to damage by birds
	210	1	510	Whole fruit	3 7	0.56 0.19

CROP, VARIETY, LOCATION, YEAR	APPLICATION RATE (g ai/ha)	NO. OF APPLIC^{N}S, INTERVAL (DAYS)	WATER VOLUME FOR FOLIAR APPLIC^{N}S (L/ha)	SAMPLE	DAYS AFTER LAST TREATMENT	FENTHION RESIDUE (mg/kg)
Nectarine ('White Flesh'), Cottonvale, Qld, 2008	UTC	–	–	Whole fruit	–	< LOQ
	200	3 (11, 4)	485	Whole fruit	0 7 14 21	2.12 0.86 0.19 0.05
	206	1	500	Whole fruit	3 7	1.07 0.50
Cherry ('Lappin'), Main Ridge, Vic., 2007	UTC	–	–	Whole fruit	–	< LOQ
	304, 360, 386	3 (7, 6)	736, 872, 936	Whole fruit	0 3 7 14	2.36 0.79 0.73 0.27
Cherry ('Lappin'), Red Hill, Vic., 2008	UTC	–	–	Whole fruit	–	< LOQ
	347, 333, 323	3 (6, 7)	840, 808, 784	Whole fruit	0 7 14 21	3.05 1.16 0.32 0.08
	330	1	800	Whole fruit	7	0.61
Cherry ('Stella'), The Summit, Qld, 2008	UTC	–	–	Whole fruit	–	< LOQ
	199, 235, 217	3 (11, 5)	482, 569, 525	Whole fruit	0 7 14	1.74 0.32 0.10
	171	1	580	Whole fruit	7	0.47
Nectarine ('Fantasia'), Red Hill South, Vic., 2008	UTC	–	–	Whole fruit	–	< LOQ
	292, 286, 330	3 (7)	707, 693, 800	Whole fruit	0 7 14 21	1.18 0.36 0.09 < LOQ

LOQ = 0.01 mg/kg for each of fenthion, fenthion-sulfoxide, fenthion-sulfone, fenthion-oxon, fenthion-oxon-sulfoxide and fenthion-oxon-sulfone.

Fenthion residues are the sum of fenthion, its oxygen analogue and their sulfoxides and sulfones, expressed as fenthion.

Study number 07-HAL-005(a)GLP; Determination of residues of the active constituents: dimethoate, omethoate and fenthion, in various fruit and vegetable crops following pre-harvest applications using the formulated products, Danadim Insecticide, Nufarm Dimethoate Systemic Insecticide and Lebaycid® Insecticide spray; **Volume 3: Berries and other small fruits; Part b: Fenthion**.

The study was conducted to determine residues of fenthion in table grapes following pre-harvest applications of Lebaycid® Insecticide spray, containing 550 g/L fenthion. The trials were located at four sites in Victoria and Queensland. One to three foliar applications of Lebaycid® were made to the point of run-off at the target rate of 75 ml/100 L (41.25 g ai/100 L) with the final application approximately 1 day before harvest. Where multiple applications were made, a spray interval of approximately 21 days was used. Samples of fruit were collected between 0 and 21 days after the last application and stored frozen until analysis, which was completed within approximately 6 months.

Samples were analysed for residues of fenthion and metabolites fenthion-sulfoxide, fenthion-sulfone, oxon, oxon-sulfoxide and oxon-sulfone. Samples were homogenised and extracted into organic solvent using sonication. The solvent was evaporated and the aqueous residue partitioned against dichloromethane. The dichloromethane extracts were combined and evaporated before redissolving in acetone. An aliquot was filtered before analysis by GC-MS. Recoveries of fenthion and its metabolites from fortified control samples of table grapes were within acceptable limits as summarised in Table A2.11. Residues found in treated samples are summarised in Table A2.12.

Table A2.11: Recoveries of fenthion and metabolites from fortified control samples of table grapes

ANALYTE	CROP	FORTIFICATION RANGE	AVERAGE RECOVERY	COEFFICIENT OF VARIATION
Fenthion	Table grape	0.01 –5.0 mg/kg as fenthion	88.8%, n = 8	7.8%
Fenthion-sulfone	Table grape	0.01–5.0 mg/kg as fenthion-sulfone	90.3%, n = 8	12.5%
Fenthion-sulfoxide	Table grape	0.01–5.0 mg/kg as fenthion-sulfoxide	96.1%, n = 8	8.5%
Fenthion-oxon	Table grape	0.01–5.0 mg/kg as fenthion-oxon	87.0%, n = 8	10.8%
Fenthion-oxon-sulfone	Table grape	0.01–5.0 mg/kg as fenthion-oxon-sulfone	88.5%, n = 8	6.1%
Fenthion-oxon-sulfoxide	Table grape	0.01–5.0 mg/kg as fenthion-oxon-sulfoxide	89.8%, n = 8	11.1%

Table A2.12: Residues of fenthion in grapes following pre-harvest treatment

CROP, VARIETY, LOCATION, YEAR	APPLICATION RATE (g ai/ha)	NO. OF APPLIC^{N}S, INTERVAL (DAYS)	WATER VOLUME FOR FOLIAR APPLICATIONS (L/ha)	DAYS AFTER LAST TREATMENT	FENTHION RESIDUE (mg/kg)
Table grapes ('Crimson Seedless'), Toolamba, Vic., 2008	UTC	–	–	–	< LOQ
	378, 374, 374	3 (20, 17)	918, 909, 909	0 3 5 8	3.48 2.42 1.73 1.21
Table grapes ('Globes'), Bowen, Qld, 2008	UTC	–	–	–	< LOQ
	108, 102, 96	3 (21)	263, 248, 233	1	2.06

CROP, VARIETY, LOCATION, YEAR	APPLICATION RATE (g ai/ha)	NO. OF APPLIC^{N}S, INTERVAL (DAYS)	WATER VOLUME FOR FOLIAR APPLICATIONS (L/ha)	DAYS AFTER LAST TREATMENT	FENTHION RESIDUE (mg/kg)
Table grapes ('Crimson Seedless'), Toolamba, Vic., 2009	UTC	–	–	–	< LOQ
	407, 424, 428	3 (7, 8)	990, 1030, 1040	0 6 14 20	1.95 0.69 0.31 0.07
	428	1	1040	6 14	0.77 0.19
Table grapes ('Crimson Seedless'), Ardmona, Vic., 2008	UTC	–	–	–	< LOQ
	352, 407, 374	3 (20, 17)	855, 987, 909	0 3 5 8	2.05 0.95 1.16 0.47

LOQ = 0.01 mg/kg for each of fenthion, fenthion-sulfoxide, fenthion-sulfone, fenthion-oxon, fenthion-oxon-sulfoxide and fenthion-oxon-sulfone.

Fenthion residues are the sum of fenthion, its oxygen analogue and their sulfoxides and sulfones, expressed as fenthion.

Study number 07-HAL-005(a)GLP; Determination of residues of the active constituents: dimethoate, omethoate and fenthion, in various fruit and vegetable crops following pre-harvest applications using the formulated products, Danadim Insecticide, Nufarm Dimethoate Systemic Insecticide and Lebaycid® Insecticide spray, **Volume 4: (Assorted tropical and sub-tropical fruits—edible peel), Part b: Fenthion.**

The study was conducted to determine residues of fenthion in persimmon following pre-harvest application of Lebaycid® Insecticide Spray, containing 550 g/L fenthion. One to three applications were made to the point of run-off at the targeted concentration of 75 mL/100 L (41.25 g ai/100 L). The final application was approximately 7 days before harvest. Where multiple applications were made, a spray interval of approximately 7 days was used. Samples of whole fruit were collected between 0 and 21 days after the final application and stored frozen until analysis, which was completed within 5 months.

Samples were analysed for residues of fenthion and metabolites fenthion-sulfoxide, fenthion-sulfone, oxon, oxon-sulfoxide and oxon-sulfone. Samples were homogenised and extracted into organic solvent using sonication. The solvent was evaporated and the aqueous residue partitioned against dichloromethane. The dichloromethane extracts were combined and evaporated before redissolving in acetone. An aliquot was filtered before analysis by GC-MS. Recoveries of fenthion and its metabolites from fortified control samples of persimmon were within acceptable limits as summarised in Table A2.13. Residues found in treated samples are summarised in Table A2.14.

Table A2.13: Recoveries of fenthion and metabolites from fortified control samples of persimmon

ANALYTE	CROP	FORTIFICATION RANGE	AVERAGE RECOVERY	COEFFICIENT OF VARIATION
Fenthion	Persimmon	0.01–5.0 mg/kg as fenthion	86.1%, n = 8	5.8%
Fenthion-sulfone	Persimmon	0.01–5.0 mg/kg as fenthion-sulfone	96.1%, n = 8	8.2%
Fenthion-sulfoxide	Persimmon	0.01–5.0 mg/kg as fenthion-sulfoxide	91.9%, n = 8	10.3%
Fenthion-oxon	Persimmon	0.01–5.0 mg/kg as fenthion-oxon	87.4%, n = 8	8.1%
Fenthion-oxon-sulfone	Persimmon	0.01–5.0 mg/kg as fenthion-oxon-sulfone	88.3%, n = 8	13.0%
Fenthion-oxon-sulfoxide	Persimmon	0.01–5.0 mg/kg as fenthion-oxon-sulfoxide	93.2%, n = 8	8.5%

Table A2.14: Residues of fenthion in persimmon following pre-harvest treatment

CROP, VARIETY, LOCATION, YEAR	APPLICATION RATE (g ai/ha)	NO. OF APPLICATIONS, INTERVAL (DAYS)	WATER VOLUME FOR FOLIAR APPLICATIONS (L/ha)	DAYS AFTER LAST TREATMENT	FENTHION RESIDUE (mg/kg)
Persimmon, Nambour, Qld, 2008	UTC	–	–	–	< LOQ
	223, 195, 212	3 (7, 6)	541, 475, 515	0 3 5 8	1.88 1.65 1.21 0.68
Persimmon (Fuji), Nambour, Qld, 2009	UTC	–	–	–	< LOQ
	173, 163, 163	3 (7, 7)	421, 396, 396	0 7 14 21	2.37 0.37 0.17 0.06
	166	1	403	7 11	0.84 0.31

LOQ = 0.01 mg/kg for each of fenthion, fenthion-sulfoxide, fenthion-sulfone, fenthion-oxon, fenthion-oxon-sulfoxide and fenthion-oxon-sulfone.

Fenthion residues are the sum of fenthion, its oxygen analogue and their sulfoxides and sulfones, expressed as fenthion.

Study number 07-HAL-005(a)GLP; Determination of residues of the active constituents: dimethoate, omethoate and fenthion, in various fruit and vegetable crops following pre-harvest applications using the formulated products, Danadim Insecticide, Nufarm Dimethoate Systemic Insecticide and Lebaycid® Insecticide Spray, **Volume 9: Fruiting vegetables, other than cucurbits; Part b: Fenthion.**

The study was conducted to determine residues of fenthion in tomatoes, eggplant and capsicums following pre-harvest applications of Lebaycid® Insecticide Spray, containing 550 g/L fenthion. The study was conducted in field and protected cropping situations at 9 sites across Australia. Three applications were

made to the point of run-off at the targeted concentration of 75 mL/100 L (41.25 g ai/100 L). The interval between applications was approximately 7 days, with the last application approximately 7 days before harvest. Samples of whole fruit were collected at 0, 3, 7 and 14 days after the last application and stored frozen until analysis, which was completed within 6 months.

Samples were analysed for residues of fenthion and metabolites fenthion-sulfoxide, fenthion-sulfone, oxon, oxon-sulfoxide and oxon-sulfone. Samples were homogenised and extracted into organic solvent using sonication. The solvent was evaporated and the aqueous residue partitioned against dichloromethane. The dichloromethane extracts were combined and evaporated before redissolving in acetone. An aliquot was filtered before analysis by GC-MS. Recoveries of fenthion and its metabolites from fortified control samples of tomato, eggplant and capsicum were within acceptable limits as summarised in Table A2.15. Residues found in treated samples are summarised in Table A2.16.

Table A2.15: Recoveries of fenthion and metabolites from fortified control samples of tomato, eggplant and capsicum

ANALYTE	CROP	FORTIFICATION RANGE	AVERAGE RECOVERY	COEFFICIENT OF VARIATION
Fenthion	Tomato	0.01–5.0 mg/kg as fenthion	92.4%, n = 6	10.9%
	Eggplant	0.01–5.0 mg/kg as fenthion	89.7%, n = 8	10.9%
	Capsicum	0.01–5.0 mg/kg as fenthion	85.0%, n = 10	8.9%
Fenthion-sulfone	Tomato	0.01–5.0 mg/kg as fenthion-sulfone	86.0%, n = 6	7.9%
	Eggplant	0.01–5.0 mg/kg as fenthion-sulfone	86.3%, n = 8	8.6%
	Capsicum	0.01–5.0 mg/kg as fenthion-sulfone	93.4%, n = 10	7.9%
Fenthion-sulfoxide	Tomato	0.01–5.0 mg/kg as fenthion-sulfoxide	93.3%, n = 6	9.9%
	Eggplant	0.01–5.0 mg/kg as fenthion-sulfoxide	87.4%, n = 8	8.3%
	Capsicum	0.01–5.0 mg/kg as fenthion-sulfoxide	90.6%, n = 10	10.7%
Fenthion-oxon	Tomato	0.01–5.0 mg/kg as fenthion-oxon	87.7%, n = 6	13.8%
	Eggplant	0.01–5.0 mg/kg as fenthion-oxon	87.5%, n = 8	8.0%
	Capsicum	0.01–5.0 mg/kg as fenthion-oxon	89.4%, n = 10	9.7%
Fenthion-oxon-sulfone	Tomato	0.01–5.0 mg/kg as fenthion-oxon-sulfone	86.0%, n = 6	9.3%
	Eggplant	0.01–5.0 mg/kg as fenthion-oxon-sulfone	86.3%, n = 8	9.2%
	Capsicum	0.01–5.0 mg/kg as fenthion-oxon-sulfone	90.4%, n = 10	10.4%

ANALYTE	CROP	FORTIFICATION RANGE	AVERAGE RECOVERY	COEFFICIENT OF VARIATION
Fenthion-oxon-sulfoxide	Tomato	0.01–5.0 mg/kg as fenthion-oxon-sulfoxide	91.2%, n = 6	11.3%
	Eggplant	0.01–5.0 mg/kg as fenthion-oxon-sulfoxide	87.6%, n = 8	10.2%
	Capsicum	0.01–5.0 mg/kg as fenthion-oxon-sulfoxide	93.5%, n = 10	10.1%

Table A2.16: Residues of fenthion in tomatoes, eggplant and capsicum following pre-harvest treatment

CROP, VARIETY, LOCATION, YEAR	APPLICATION RATE (g ai/ha)	NO. OF APPLICATIONS, INTERVAL (DAYS)	WATER VOLUME FOR FOLIAR APPLICATIONS (L/ha)	DAYS AFTER LAST TREATMENT	FENTHION RESIDUE (mg/kg)
Tomato ('Processing), Echuca, Vic., 2008	UTC	–	–	–	< LOQ
	380, 396, 396	3 (6, 7)	920, 960, 960	0 3 7 15	1.09 0.59 0.76 0.18
Tomato ('Swanson'), Virginia, SA, 2008	UTC	–	–	–	< LOQ
	462, 429, 469	3 (7, 6)	1130, 1040, 1138	0 3 7 14	1.65 1.28 0.95 0.51
Tomato ('Guardian'), Ayr, Qld, 2008	UTC	–	–	–	< LOQ
	228, 245, 267	3 (7, 6)	552, 594, 648	7	0.53
Eggplant ('Black Prince'), Fredericksfield, Qld, 2008	UTC	–	–	–	< LOQ
	250, 225, 257	3 (7, 7)	606, 546, 624	1 4 6 7	1.69 1.13 0.28 0.36
Eggplant ('Chiha'), Meadowvale, Qld, 2008	UTC	–	–	–	< LOQ
	404, 417, 417	3 (6, 8)	980, 1010, 1010	1 3 5 7	1.12 0.74 0.35 0.23
Capsicum, hydroponic ('Inspiration'), Kindred, Tas., 2008	UTC	–	–	–	< LOQ
	206, 206, 215	3 (7, 6)	500, 500, 520	0 3 7 14	0.64 0.24 0.09 0.04

CROP, VARIETY, LOCATION, YEAR	APPLICATION RATE (g ai/ha)	NO. OF APPLICATIONS, INTERVAL (DAYS)	WATER VOLUME FOR FOLIAR APPLICATIONS (L/ha)	DAYS AFTER LAST TREATMENT	FENTHION RESIDUE (mg/kg)
Capsicum ('Warlock'), Gatton, Qld, 2008	UTC	–	–	–	< LOQ
	446, 426, 405	3 (6, 7)	1080, 1033, 983	0 3 7 14	0.35 0.41 0.05 0.02
Capsicum ('Remy), Virginia, SA, 2008	UTC	–	–	–	< LOQ
	243, 204, 208	3 (6, 8)	590, 495, 505	0 3 7 14	1.03 0.57 0.24 0.07
Capsicum, hydroponic, ('Red Inspiration'), Kemps Creek, NSW, 2009	UTC	–	–	–	< LOQ
	306, 309, 315	3 (7, 7)	742, 749, 763	0 3 7 14	0.28 0.37 0.13 0.03

LOQ = 0.01 mg/kg for each of fenthion, fenthion-sulfoxide, fenthion-sulfone, fenthion-oxon, fenthion-oxon-sulfoxide and fenthion-oxon-sulfone.

Fenthion residues are the sum of fenthion, its oxygen analogue and their sulfoxides and sulfones, expressed as fenthion.

Study number 07-HAL-005(b)GLP; Determination of residues of the active constituents: dimethoate and omethoate, or fenthion, in various fruits and vegetables following post-harvest dipping in solutions containing the formulated products, Danadim or Lebaycid®, respectively, **Volume 3 (Assorted tropical and sub-tropical fruits—inedible peel), Part b (Fenthion).**

The study was conducted to determine residues of fenthion in avocado, custard apple, mangoes and papaya (papaw) following post-harvest dipping with Lebaycid® Insecticide Spray, containing 550 g/L fenthion. Fruit were harvested from 11 sites in tropical and sub-tropical Queensland. Fruit were dipped for 60 seconds in at least 50 L of dip solution containing Lebaycid® Insecticide Spray at a concentration of 75 ml/100 L (41.25 g ai/100 L). After removal from the dip solution, samples were left in sheltered ambient conditions to air dry for at least 30 minutes. Once dry, samples were frozen until analysis, which was completed within 6 months.

Samples were analysed for residues of fenthion and metabolites fenthion-sulfoxide, fenthion-sulfone, oxon, oxon-sulfoxide and oxon-sulfone. Samples were homogenised and extracted into organic solvent using sonication. The solvent was evaporated and the aqueous residue partitioned against dichloromethane. The dichloromethane extracts were combined and evaporated before redissolving in acetone. An aliquot was filtered before analysis by GC-MS. Recoveries of fenthion and its metabolites from fortified control samples of avocado, custard apple, mango and papaya (papaw) pulp and skins were within acceptable limits as summarised in Table A2.17. Residues found in treated samples are summarised in Table A2.18.

Table A2.17: Recoveries of fenthion and metabolites from fortified control samples of avocado, custard apple, mango and papaya pulp and skins

ANALYTE	CROP/PORTION	FORTIFICATION RANGE	AVERAGE RECOVERY	COEFFICIENT OF VARIATION
Fenthion	Avocado pulp	0.01–5.0 mg/kg as fenthion	93.5%, n = 8	8.5%
	Avocado skin	0.01–5.0 mg/kg as fenthion	84.8%, n = 8	8.3%
	Custard apple pulp	0.01–5.0 mg/kg as fenthion	88.7%, n = 6	11.1%
	Custard apple skin	0.01–5.0 mg/kg as fenthion	89.6%, n = 6	10.4%
	Mango pulp	0.01–5.0 mg/kg as fenthion	85.6%, n = 6	8.5%
	Mango skin	0.01–5.0 mg/kg as fenthion	92.0%, n = 6	12.2%
	Papaya pulp	0.01–5.0 mg/kg as fenthion	87.0%, n = 6	10.9%
	Papaya skin	0.01–5.0 mg/kg as fenthion	87.8%, n = 6	8.6%
Fenthion-sulfone	Avocado pulp	0.01–5.0 mg/kg as fenthion-sulfone	93.8%, n = 8	9.3%
	Avocado skin	0.01–5.0 mg/kg as fenthion-sulfone	94.9%, n = 8	5.1%
	Custard apple pulp	0.01–5.0 mg/kg as fenthion-sulfone	91.2%, n = 6	11.7%
	Custard apple skin	0.01–5.0 mg/kg as fenthion-sulfone	95.4%, n = 6	5.7%
	Mango pulp	0.01–5.0 mg/kg as fenthion-sulfone	90.5%, n = 6	10.6%
	Mango skin	0.01–5.0 mg/kg as fenthion-sulfone	81.3%, n = 6	5.5%
	Papaya pulp	0.01–5.0 mg/kg as fenthion-sulfone	87.6%, n = 6	10.0%
	Papaya skin	0.01–5.0 mg/kg as fenthion-sulfone	88.6%, n = 6	10.4%
Fenthion-sulfoxide	Avocado pulp	0.01–5.0 mg/kg as fenthion-sulfoxide	91.1%, n = 8	10.3%
	Avocado skin	0.01–5.0 mg/kg as fenthion-sulfoxide	91.5%, n = 8	9.3%
	Custard apple pulp	0.01–5.0 mg/kg as fenthion-sulfoxide	88.6%, n = 6	11.0%
	Custard apple skin	0.01–5.0 mg/kg as fenthion-	92.7%, n = 6	8.9%

ANALYTE	CROP/PORTION	FORTIFICATION RANGE	AVERAGE RECOVERY	COEFFICIENT OF VARIATION
		sulfoxide		
	Mango pulp	0.01–5.0 mg/kg as fenthion-sulfoxide	89.0%, n = 6	10.7%
	Mango skin	0.01–5.0 mg/kg as fenthion-sulfoxide	91.3%, n = 6	7.3%
	Papaya pulp	0.01–5.0 mg/kg as fenthion-sulfoxide	81.9%, n = 6	7.2%
	Papaya skin	0.01–5.0 mg/kg as fenthion-sulfoxide	87.5%, n = 6	10.7%
Fenthion-oxon	Avocado pulp	0.01–5.0 mg/kg as fenthion-oxon	86.4%, n = 8	9.1%
	Avocado skin	0.01–5.0 mg/kg as fenthion-oxon	90.6%, n = 8	8.1%
	Custard apple pulp	0.01–5.0 mg/kg as fenthion-oxon	88.8%, n = 6	11.2%
	Custard apple skin	0.01–5.0 mg/kg as fenthion-oxon	87.3%, n = 6	9.6%
	Mango pulp	0.01–5.0 mg/kg as fenthion-oxon	88.2%, n = 6	10.9%
	Mango skin	0.01–5.0 mg/kg as fenthion-oxon	88.4%, n = 6	8.0%
	Papaya pulp	0.01–5.0 mg/kg as fenthion-oxon	89.2%, n = 6	10.9%
	Papaya skin	0.01–5.0 mg/kg as fenthion-oxon	88.3%, n = 6	9.2%
Fenthion-oxon-sulfone	Avocado pulp	0.01–5.0 mg/kg as fenthion-oxon-sulfone	91.1%, n = 8	10.2%
	Avocado skin	0.01–5.0 mg/kg as fenthion-oxon-sulfone	91.8%, n = 8	9.6%
	Custard apple pulp	0.01–5.0 mg/kg as fenthion-oxon-sulfone	91.4%, n = 6	9.7%
	Custard apple skin	0.01–5.0 mg/kg as fenthion-oxon-sulfone	95.4%, n = 6	7.2%
	Mango pulp	0.01–5.0 mg/kg as fenthion-oxon-sulfone	86.9%, n = 6	10.9%
	Mango skin	0.01–5.0 mg/kg as fenthion-	91.2%, n = 6	10.5%

ANALYTE	CROP/PORTION	FORTIFICATION RANGE	AVERAGE RECOVERY	COEFFICIENT OF VARIATION
		oxon-sulfone		
	Papaya pulp	0.01–5.0 mg/kg as fenthion-oxon-sulfone	92.2%, n = 6	10.9%
	Papaya skin	0.01–5.0 mg/kg as fenthion-oxon-sulfone	88.3%, n = 6	12.4%
Fenthion-oxon-sulfoxide	Avocado pulp	0.01–5.0 mg/kg as fenthion-oxon-sulfoxide	85.5%, n = 8	7.9%
	Avocado skin	0.01–5.0 mg/kg as fenthion-oxon-sulfoxide	89.4%, n = 8	10.8%
	Custard apple pulp	0.01–5.0 mg/kg as fenthion-oxon-sulfoxide	84.9%, n = 6	13.5%
	Custard apple skin	0.01–5.0 mg/kg as fenthion-oxon-sulfoxide	91.2%, n = 6	8.0%
	Mango pulp	0.01–5.0 mg/kg as fenthion-oxon-sulfoxide	88.3%, n = 6	11.0%
	Mango skin	0.01–5.0 mg/kg as fenthion-oxon-sulfoxide	92.0%, n = 6	6.3%
	Papaya pulp	0.01–5.0 mg/kg as fenthion-oxon-sulfoxide	94.5%, n = 6	9.5%
	Papaya skin	0.01–5.0 mg/kg as fenthion-oxon-sulfoxide	92.7%, n = 6	10.4%

Table A2.18: Residues of fenthion in avocado, custard apple, mango and papaya after post-harvest treatment

CROP, VARIETY, LOCATION, YEAR	TREATMENT	SPECIMEN TYPE	SAMPLING TIME	FENTHION RESIDUE (mg/kg)
Avocado ('Shepard'), Home Hill, Qld, 2008	41.25 g ai/100 L	Dip solution	0 DAT	396
	UTC	Skin	–	< LOQ
		Pulp	–	< LOQ
	41.25 g ai/100 L	Skin	0 DAT	6.78
		Pulp	0 DAT	0.03
		Whole fruit	0 DAT	0.97
Avocado ('Hass'),	41.25 g ai/100 L	Dip solution	0 DAT	405

CROP, VARIETY, LOCATION, YEAR	TREATMENT	SPECIMEN TYPE	SAMPLING TIME	FENTHION RESIDUE (mg/kg)
Beerwah, Qld, 2008	UTC	Skin	–	< LOQ
		Pulp	–	< LOQ
	41.25 g ai/100 L	Skin	0 DAT	5.61
		Pulp	0 DAT	0.05
		Whole fruit	0 DAT	0.88
Avocado ('Shepard'), Childers, Qld, 2008	41.25 g ai/100 L	Dip solution	0 DAT	389
	UTC	Skin	–	< LOQ
		Pulp	–	< LOQ
	41.25 g ai/100 L	Skin	0 DAT	7.34
		Pulp	0 DAT	0.07
		Whole fruit	0 DAT	1.29
Avocado ('Hass'), Glass House Mountains, Qld, 2009	41.25 g ai/100 L	Dip solution	0 DAT	427
	UTC	Skin	–	< LOQ
		Pulp	–	< LOQ
	41.25 g ai/100 L	Skin	0 DAT	6.86
		Pulp	0 DAT	0.03
		Whole fruit	0 DAT	1.05
Custard apple ('African Prickle'), Tolga, Qld, 2008	41.25 g ai/100 L	Dip solution	0 DAT	399
	UTC	Skin	–	< LOQ
		Pulp	–	< LOQ
	41.25 g ai/100 L	Skin	0 DAT	4.97
		Pulp	0 DAT	0.06
		Whole fruit	0 DAT	1.58
Custard apple ('Maroochy Gold'), Nambour, Qld, 2008	41.25 g ai/100 L	Dip solution	0 DAT	420
	UTC	Skin	–	< LOQ
		Pulp	–	< LOQ

CROP, VARIETY, LOCATION, YEAR	TREATMENT	SPECIMEN TYPE	SAMPLING TIME	FENTHION RESIDUE (mg/kg)
	41.25 g ai/100 L	Skin	0 DAT	8.99
		Pulp	0 DAT	0.02
		Whole fruit	0 DAT	2.71
Mango ('Kensington Pride'), Childers, Qld, 2009	41.25 g ai/100 L	Dip solution	0 DAT	401
	UTC	Skin	–	< LOQ
		Pulp	–	< LOQ
	41.25 g ai/100 L	Skin	0 DAT	6.98
		Pulp	0 DAT	0.07
		Whole fruit	0 DAT	1.30
Mango ('Keit'), Childers, Qld, 2009	41.25 g ai/100 L	Dip solution	0 DAT	388
	UTC	Skin	–	< LOQ
		Pulp	–	< LOQ
	41.25	Skin	0 DAT	9.63
		Pulp	0 DAT	0.09
		Whole fruit	0 DAT	1.51
Mango ('R2E2'), Bowen, Qld, 2009	Results not reported—samples thawed due to freezer failure			
Papaya ('Hybrid 1B'), Mareeba, Qld, 2008	41.25 g ai/100 L	Dip solution	0 DAT	402
	UTC	Skin	–	< LOQ
		Pulp	–	< LOQ
	41.25 g ai/100 L	Skin	0 DAT	7.84
		Pulp	0 DAT	0.03
Papaya ('Richters Gold'), Mooloo, Qld, 2008	41.25 g ai/100 L	Dip solution	0 DAT	366
	UTC	Skin	–	< LOQ
		Pulp	–	< LOQ
	41.25 g ai/100 L	Skin	0 DAT	9.22
		Pulp	0 DAT	0.05

LOQ = 0.01 mg/kg for each of fenthion, fenthion-sulfoxide, fenthion-sulfone, fenthion-oxon, fenthion-oxon-sulfoxide and fenthion-oxon-sulfone.

Fenthion residues are the sum of fenthion, its oxygen analogue and their sulfoxides and sulfones, expressed as fenthion.

Study number 07-HAL-005(b)GLP; Determination of residues of the active constituents: dimethoate and omethoate, or fenthion, in various fruits and vegetables following post-harvest dipping in solutions containing the formulated products, Danadim or Lebaycid®, respectively; **Volume 4 (Fruiting vegetables [cucurbits]); Part b (Fenthion).**

The study was conducted to determine residues of fenthion in rockmelons following post-harvest dipping with Lebaycid® Insecticide spray containing 550 g/L fenthion. The rockmelons were collected from three study sites in Queensland and dipped for 60 seconds in at least 50 L of a dip solution containing Lebaycid® Insecticide spray at 75 mL/100 L (41.25 g ai/100 L). On removal from the dip solution, samples were left in sheltered, ambient conditions to air dry for at least 30 minutes. Once dry, samples were frozen until analysis, which was completed within 4 months.

Samples were analysed for residues of fenthion and metabolites fenthion-sulfoxide, fenthion-sulfone, oxon, oxon-sulfoxide and oxon-sulfone. Samples were homogenised and extracted into organic solvent using sonication. The solvent was evaporated and the aqueous residue partitioned against dichloromethane. The dichloromethane extracts were combined and evaporated before redissolving in acetone. An aliquot was filtered before analysis by GC-MS. Recoveries of fenthion and its metabolites from fortified control samples of rockmelon pulp and skin were within acceptable limits as summarised in Table A2.19. Residues found in treated samples are summarised in Table A2.20.

Table A2.19: Recoveries of fenthion and metabolites from fortified control samples of rockmelon pulp and skin

ANALYTE	CROP/PORTION	FORTIFICATION RANGE	AVERAGE RECOVERY	COEFFICIENT OF VARIATION
Fenthion	Rockmelon pulp	0.01 –5.0 mg/kg as fenthion	87.9%, n = 8	10.9%
	Rockmelon skin	0.01 –5.0 mg/kg as fenthion	88.6%, n = 8	10.9%
Fenthion-sulfone	Rockmelon pulp	0.01 –5.0 mg/kg as fenthion-sulfone	90.1%, n = 8	10.4%
	Rockmelon skin	0.01 –5.0 mg/kg as fenthion-sulfone	89.6%, n = 8	9.0%
Fenthion-sulfoxide	Rockmelon pulp	0.01 –5.0 mg/kg as fenthion-sulfoxide	89.3%, n = 8	9.2%
	Rockmelon skin	0.01 –5.0 mg/kg as fenthion-sulfoxide	89.3%, n = 8	11.3%
Fenthion-oxon	Rockmelon pulp	0.01 –5.0 mg/kg as fenthion-oxon	88.6%, n = 8	10.9%
	Rockmelon skin	0.01 –5.0 mg/kg as fenthion-oxon	91.4%, n = 8	11.8%

Fenthion-oxon-sulfone	Rockmelon pulp	0.01 –5.0 mg/kg as fenthion-oxon-sulfone	93.7%, n = 8	8.2%
	Rockmelon skin	0.01 –5.0 mg/kg as fenthion-oxon-sulfone	87.3%, n = 8	10.2%
Fenthion-oxon-sulfoxide	Rockmelon pulp	0.01 –5.0 mg/kg as fenthion-oxon-sulfoxide	85.9%, n = 8	8.5%
	Rockmelon skin	0.01 –5.0 mg/kg as fenthion oxon-sulfoxide	91.5%, n = 8	11.2%

Table A2.20: Residues of fenthion in rockmelon after post-harvest treatment

CROP, VARIETY, LOCATION, YEAR	TREATMENT	SPECIMEN TYPE	SAMPLING TIME	FENTHION RESIDUE (mg/kg)
Rockmelon ('Hot Shot'), Home Hill, Qld, 2008	41.25 g ai/100 L	Dip solution	0 DAT	392
	UTC	Skin	–	< LOQ
		Pulp	–	< LOQ
	41.25 g ai/100 L	Skin	0 DAT	6.93
		Pulp	0 DAT	0.04
Rockmelon ('Colorado'), Bowen, Qld, 2009	41.25 g ai/100 L	Dip solution	0 DAT	430
	UTC	Skin	–	< LOQ
		Pulp	–	< LOQ
	41.25 g ai/100 L	Skin	0 DAT	5.17
		Pulp	0 DAT	0.02
Rockmelon ('Oakley'), Bundaberg, Qld, 2008	41.25 g ai/100 L	Dip solution	0 DAT	379
	UTC	Skin	–	< LOQ
		Pulp	–	< LOQ
	41.25 g ai/100 L	Skin	0 DAT	3.28
		Pulp	0 DAT	0.06

LOQ = 0.01 mg/kg for each of fenthion, fenthion-sulfoxide, fenthion-sulfone, fenthion-oxon, fenthion-oxon-sulfoxide and fenthion-oxon-sulfone.

Fenthion residues are the sum of fenthion, its oxygen analogue and their sulfoxides and sulfones, expressed as fenthion.

Study number 09-HAL-017GLP; Determination of residues of: dimethoate and omethoate, or fenthion, in various edible-skinned vegetable crops following post-harvest dipping with Nufarm Dimethoate Systemic Insecticide and Lebaycid® Insecticide Spray.

A GLP study was conducted in Australia in 2009 to determine residues of dimethoate and omethoate or fenthion in fruiting vegetables (cucurbits and others) following post-harvest dip treatment. The study included fruit collected from four cucumber field sites, five zucchini field sites, six capsicum field sites and two eggplant field sites. Two lots of at least 12 fruit were randomly collected from throughout the crop at each field site. One lot was kept as a control. The other lot was treated by immersing them for 60 seconds in a dip solution that contained either Nufarm Dimethoate Systemic Insecticide (containing 400 g/L dimethoate) at 50 or 100 mL/100 L water (20 or 40 g ai/100 L) or Lebaycid Insecticide Spray (containing 550 g/L fenthion) at 18.75, 37.5 or 75 mL/100 L water (10.3, 20.6 or 41.3 g ai/100 L). After removal from the dip solution, fruit were left to air dry in shaded, ambient conditions or in a refrigerator for between 1 hour and 7 days before being placed in frozen storage. Analysis took place within 6 months. Only the results for fenthion will be discussed in this evaluation.

For fenthion samples were homogenised and subsamples extracted into organic solvent using high-powered ultrasonication and mechanical shaking. The solvent is evaporated under vacuum and the aqueous residue partitioned against dichloromethane. The dichloromethane extracts are combined and evaporated under vacuum to dryness before redissolving in acetone. An aliquot is filtered before determination of fenthion, fenthion-sulfoxide, fenthion-sulfone, fenthion oxon, fenthion oxon-sulfoxide and fenthion oxonsulfone by GC–MS/MS or SIM. The LOQ was 0.01 mg/kg for each analyte. Recoveries of fenthion and its metabolites from fortified control samples of cucumber, zucchini, capsicum and eggplant were within acceptable limits as summarised in Table A2.21.

Table A2.21: Recoveries of fenthion and metabolites from fortified control samples

ANALYTE	CROP	RANGE OF FORTIFICATION	AVERAGE RECOVERY	COEFFICIENT OF VARIATION
Fenthion	Cucumber	0.01 –5.00 mg/kg as fenthion	89.2% (n = 8)	7.8%
	Zucchini	0.01 –5.00 mg/kg as fenthion	89.9% (n = 8)	7.5%
	Capsicum	0.01 –5.00 mg/kg as fenthion	86.0% (n = 4)	7.1%
	Eggplant	0.01 –5.00 mg/kg as fenthion	92.5% (n = 4)	7.4%
Fenthion-sulfone	Cucumber	0.01 –5.00 mg/kg as fenthion-sulfone	91.3% (n = 8)	10.5%
	Zucchini	0.01 –5.00 mg/kg as fenthion-sulfone	89.2% (n = 8)	7.8%
	Capsicum	0.01 –5.00 mg/kg as fenthion-sulfone	92.0% (n = 4)	6.6%
	Eggplant	0.01 –5.00 mg/kg as fenthion-sulfone	92.5% (n = 4)	8.5%
Fenthion-sulfoxide	Cucumber	0.01 –5.00 mg/kg as fenthion-sulfoxide	93.7% (n = 8)	7.9%
	Zucchini	0.01 –5.00 mg/kg as fenthion-sulfoxide	90.4% (n = 8)	8.7%
	Capsicum	0.01 –5.00 mg/kg as fenthion-sulfoxide	86.0% (n = 4)	9.9%
	Eggplant	0.01 –5.00 mg/kg as fenthion-sulfoxide	88.4% (n = 4)	9.6%
Fenthion-oxon	Cucumber	0.01 –5.00 mg/kg as fenthion-oxon	90.6% (n = 8)	8.2%

ANALYTE	CROP	RANGE OF FORTIFICATION	AVERAGE RECOVERY	COEFFICIENT OF VARIATION
	Zucchini	0.01 –5.00 mg/kg as fenthion-oxon	87.5% (n = 8)	10.3%
	Capsicum	0.01 –5.00 mg/kg as fenthion-oxon	87.3% (n = 4)	8.0%
	Eggplant	0.01 –5.00 mg/kg as fenthion-oxon	89.9% (n = 4)	6.2%
Fenthion-oxon-sulfone	Cucumber	0.01 –5.00 mg/kg as fenthion-oxon-sulfone	93.7% (n = 8)	7.0%
	Zucchini	0.01 –5.00 mg/kg as fenthion-oxon-sulfone	90.3% (n = 8)	6.5%
	Capsicum	0.01 –5.00 mg/kg as fenthion-oxon-sulfone	93.8% (n = 4)	9.8%
	Eggplant	0.01 –5.00 mg/kg as fenthion-oxon-sulfone	92.9% (n = 4)	6.7%
Fenthion-oxon-sulfoxide	Cucumber	0.01 –5.00 mg/kg as fenthion-oxon-sulfoxide	87.5% (n = 8)	8.5%
	Zucchini	0.01 –5.00 mg/kg as fenthion-oxon-sulfoxide	88.0% (n = 8)	9.1%
	Capsicum	0.01 –5.00 mg/kg as fenthion-oxon-sulfoxide	89.2% (n = 4)	11.5%
	Eggplant	0.01 –5.00 mg/kg as fenthion-oxon-sulfoxide	90.2% (n = 4)	11.3%

Residues of fenthion were below quantifiable limits in all untreated control samples from the 17 field sites. Residues found in treated samples are summarised in Table A2.22.

Table A2.22: Residues of fenthion in fruiting vegetables after post-harvest treatment

CROP, TRIAL SITE	TEST ITEM	TREATMENT	SPECIMEN TYPE	SAMPLING TIME	FENTHION RESIDUE (mg/kg)
Cucumber, Forthside, Tas., 2009	UTC	–	Whole fruit	–	< LOQ
	Fenthion	10.51 g ai/100 L	Whole fruit	0 DAT	1.48
		21.03 g ai/100 L	Whole fruit	0 DAT	2.09
		42.07 g ai/100 L	Whole fruit	0 DAT	5.12
	Fenthion	10.51 g ai/100 L	Dip solution	0 DAT	94
		21.03 g ai/100 L	Dip solution	0 DAT	191
		42.07 g ai/100 L	Dip solution	0 DAT	386
	Fenthion	10.51 g ai/100 L	Whole fruit	3 DAT	0.46
		21.03 g ai/100 L	Whole fruit	3 DAT	1.34
		42.07 g ai/100 L	Whole fruit	3 DAT	1.79
	Fenthion	10.51 g ai/100 L	Whole fruit	5 DAT	0.38

CROP, TRIAL SITE	TEST ITEM	TREATMENT	SPECIMEN TYPE	SAMPLING TIME	FENTHION RESIDUE (mg/kg)
		21.03 g ai/100 L	Whole fruit	5 DAT	0.89
		42.07 g ai/100 L	Whole fruit	5 DAT	1.15
	Fenthion	10.51 g ai/100 L	Whole fruit	7 DAT	0.18
		21.03 g ai/100 L	Whole fruit	7 DAT	0.16
		42.07 g ai/100 L	Whole fruit	7 DAT	0.40
Cucumber ('Camelat'), Arkendeith, Qld, 2009	UTC	–	Whole fruit	–	< LOQ
	Fenthion	10.50 g ai/100 L	Whole fruit	0 DAT	0.91
		42.0 g ai/100 L	Whole fruit	0 DAT	3.40
	Fenthion	10.50 g ai/100 L	Dip solution	0 DAT	115
		42.0 g ai/100 L	Dip solution	0 DAT	428
	Fenthion	10.50 g ai/100 L	Whole fruit	3 DAT	0.82
		42.0 g ai/100 L	Whole fruit	3 DAT	1.97
	Fenthion	10.50 g ai/100 L	Whole fruit	5 DAT	0.24
		42.0 g ai/100 L	Whole fruit	5 DAT	0.98
	Fenthion	10.50 g ai/100 L	Whole fruit	7 DAT	0.09
		42.0 g ai/100 L	Whole fruit	7 DAT	0.22
Cucumber ('Camen'), Waterloo, SA, 2009	UTC	–	Whole fruit	–	< LOQ
	Fenthion	10.50 g ai/100 L	Whole fruit	0 DAT	0.74
		21.03 g ai/100 L	Whole fruit	0 DAT	2.13
		42.00 g ai/100 L	Whole fruit	0 DAT	2.67
	Fenthion	10.50 g ai/100 L	Dip solution	0 DAT	96
		21.03 g ai/100 L	Dip solution	0 DAT	215
		42.00 g ai/100 L	Dip solution	0 DAT	390
Cucumber ('Lebanese'), Kemps Creek, NSW, 2009	UTC	–	Whole fruit	–	< LOQ
	Fenthion	10.50 g ai/100 L	Whole fruit	0 DAT	0.37
		21.03 g ai/100 L	Whole fruit	0 DAT	0.51

CROP, TRIAL SITE	TEST ITEM	TREATMENT	SPECIMEN TYPE	SAMPLING TIME	FENTHION RESIDUE (mg/kg)
		42.00 g ai/100 L	Whole fruit	0 DAT	1.35
	Fenthion	10.50 g ai/100 L	Dip solution	0 DAT	117
		21.03 g ai/100 L	Dip solution	0 DAT	220
		42.00 g ai/100 L	Dip solution	0 DAT	436
Zucchini ('Amanda'), Moriarty, Tas., 2009	UTC	–	Whole fruit	–	< LOQ
	Fenthion	10.50 g ai/100 L	Whole fruit	0 DAT	0.65
		21.03 g ai/100 L	Whole fruit	0 DAT	1.49
		42.00 g ai/100 L	Whole fruit	0 DAT	2.10
	Fenthion	10.50 g ai/100 L	Dip solution	0 DAT	104
		21.03 g ai/100 L	Dip solution	0 DAT	215
		42.00 g ai/100 L	Dip solution	0 DAT	393
	Fenthion	10.50 g ai/100 L	Whole fruit	3 DAT	0.42
		21.03 g ai/100 L	Whole fruit	3 DAT	0.71
		42.00 g ai/100 L	Whole fruit	3 DAT	1.09
	Fenthion	10.50 g ai/100 L	Whole fruit	5 DAT	0.12
		21.03 g ai/100 L	Whole fruit	5 DAT	0.30
		42.00 g ai/100 L	Whole fruit	5 DAT	0.34
	Fenthion	10.50 g ai/100 L	Whole fruit	7 DAT	0.07
		21.03 g ai/100 L	Whole fruit	7 DAT	0.10
		42.00 g ai/100 L	Whole fruit	7 DAT	0.17
Zucchini ('Panther'), Doonan, Qld, 2009	UTC	–	Whole fruit	–	< LOQ
	Fenthion	10.51 g ai/100 L	Whole fruit	0 DAT	1.37
		42.07 g ai/100 L	Whole fruit	0 DAT	3.24
	Fenthion	10.51 g ai/100 L	Dip solution	0 DAT	92
		42.07 g ai/100 L	Dip solution	0 DAT	401
Zucchini ('Regal	UTC	–	Whole fruit	–	< LOQ

CROP, TRIAL SITE	TEST ITEM	TREATMENT	SPECIMEN TYPE	SAMPLING TIME	FENTHION RESIDUE (mg/kg)
Black'), Fredrickfield, Qld, 2009	Fenthion	10.51 g ai/100 L	Whole fruit	0 DAT	0.48
		21.03 g ai/100 L	Whole fruit	0 DAT	0.73
		42.07 g ai/100 L	Whole fruit	0 DAT	1.96
	Fenthion	10.51 g ai/100 L	Dip solution	0 DAT	114
		21.03 g ai/100 L	Dip solution	0 DAT	201
		42.07 g ai/100 L	Dip solution	0 DAT	430
	Fenthion	10.51 g ai/100 L	Whole fruit	3 DAT	0.21
		21.03 g ai/100 L	Whole fruit	3 DAT	0.58
		42.07 g ai/100 L	Whole fruit	3 DAT	0.83
	Fenthion	10.51 g ai/100 L	Whole fruit	5 DAT	0.24
		21.03 g ai/100 L	Whole fruit	5 DAT	0.31
		42.07 g ai/100 L	Whole fruit	5 DAT	0.44
	Fenthion	10.51 g ai/100 L	Whole fruit	7 DAT	0.09
		21.03 g ai/100 L	Whole fruit	7 DAT	0.14
		42.07 g ai/100 L	Whole fruit	7 DAT	0.23
Zucchini ('Regal'), Doonan, Qld, 2009	UTC	–	Whole fruit	–	< LOQ
	Fenthion	10.51 g ai/100 L	Whole fruit	0 DAT	0.59
		42.07 g ai/100 L	Whole fruit	0 DAT	2.17
	Fenthion	10.51 g ai/100 L	Dip solution	0 DAT	91
		42.07 g ai/100 L	Dip solution	0 DAT	449
Zucchini ('Columbia'), Kemps Creek, NSW, 2009	UTC	–	Whole fruit	–	< LOQ
	Fenthion	10.51 g ai/100 L	Whole fruit	0 DAT	0.73
		21.03 g ai/100 L	Whole fruit	0 DAT	0.44
		42.07 g ai/100 L	Whole fruit	0 DAT	0.73
	Fenthion	10.51 g ai/100 L	Dip solution	0 DAT	112
		21.03 g ai/100 L	Dip solution	0 DAT	131

CROP, TRIAL SITE	TEST ITEM	TREATMENT	SPECIMEN TYPE	SAMPLING TIME	FENTHION RESIDUE (mg/kg)
		42.07 g ai/100 L	Dip solution	0 DAT	284
Capsicum ('Zamboni'), Forthside, Tas., 2009	UTC	–	Whole fruit	–	< LOQ
	Fenthion	10.51 g ai/100 L	Whole fruit	0 DAT	1.15
		21.03 g ai/100 L	Whole fruit	0 DAT	2.53
		42.07 g ai/100 L	Whole fruit	0 DAT	6.01
	Fenthion	10.51 g ai/100 L	Dip solution	0 DAT	96
		21.03 g ai/100 L	Dip solution	0 DAT	219
		42.07 g ai/100 L	Dip solution	0 DAT	398
	Fenthion	10.51 g ai/100 L	Whole fruit	3 DAT	0.52
		21.03 g ai/100 L	Whole fruit	3 DAT	0.81
		42.07 g ai/100 L	Whole fruit	3 DAT	2.47
	Fenthion	10.51 g ai/100 L	Whole fruit	5 DAT	0.47
		21.03 g ai/100 L	Whole fruit	5 DAT	1.23
		42.07 g ai/100 L	Whole fruit	5 DAT	1.40
	Fenthion	10.51 g ai/100 L	Whole fruit	7 DAT	0.17
		21.03 g ai/100 L	Whole fruit	7 DAT	0.25
		42.07 g ai/100 L	Whole fruit	7 DAT	0.36
Capsicum ('Jackal'), Merinda, Qld, 2009	UTC	–	Whole fruit	–	< LOQ
	Fenthion	10.51 g ai/100 L	Whole fruit	0 DAT	0.90
		42.07 g ai/100 L	Whole fruit	0 DAT	2.29
	Fenthion	10.51 g ai/100 L	Dip solution	0 DAT	95
		42.07 g ai/100 L	Dip solution	0 DAT	436
	Fenthion	10.51 g ai/100 L	Whole fruit	3 DAT	0.81
		42.07 g ai/100 L	Whole fruit	3 DAT	1.53
	Fenthion	10.51 g ai/100 L	Whole fruit	5 DAT	0.32
		42.07 g ai/100 L	Whole fruit	5 DAT	0.50

CROP, TRIAL SITE	TEST ITEM	TREATMENT	SPECIMEN TYPE	SAMPLING TIME	FENTHION RESIDUE (mg/kg)
	Fenthion	10.51 g ai/100 L	Whole fruit	7 DAT	0.19
		42.07 g ai/100 L	Whole fruit	7 DAT	0.33
Capsicum ('Warlock'), Merinda, Qld, 2009	UTC	–	Whole fruit	–	< LOQ
	Fenthion	10.51 g ai/100 L	Whole fruit	0 DAT	0.83
		42.07 g ai/100 L	Whole fruit	0 DAT	1.09
	Fenthion	10.51 g ai/100 L	Dip solution	0 DAT	98
		42.07 g ai/100 L	Dip solution	0 DAT	283
Capsicum ('Warlock'), Doonan, Qld, 2009	UTC	–	Whole fruit	–	< LOQ
	Fenthion	10.51 g ai/100 L	Whole fruit	0 DAT	0.59
		42.07 g ai/100 L	Whole fruit	0 DAT	1.79
	Fenthion	10.51 g ai/100 L	Dip solution	0 DAT	95
		42.07 g ai/100 L	Dip solution	0 DAT	315
Capsicum ('Red Inspiration'), Kemps Creek, NSW, 2009	UTC	–	Whole fruit	–	< LOQ
	Fenthion	10.51 g ai/100 L	Whole fruit	0 DAT	0.78
		21.03 g ai/100 L	Whole fruit	0 DAT	0.72
		42.07 g ai/100 L	Whole fruit	0 DAT	2.06
	Fenthion	10.51 g ai/100 L	Dip solution	0 DAT	92
		21.03 g ai/100 L	Dip solution	0 DAT	141
		42.07 g ai/100 L	Dip solution	0 DAT	317
Capsicum ('Remy'), Waterloo Corner, SA, 2009	UTC	–	Whole fruit	–	< LOQ
	Fenthion	10.51 g ai/100 L	Whole fruit	0 DAT	1.39
		21.03 g ai/100 L	Whole fruit	0 DAT	0.47
		42.07 g ai/100 L	Whole fruit	0 DAT	1.06
	Fenthion	10.51 g ai/100 L	Dip solution	0 DAT	107
		21.03 g ai/100 L	Dip solution	0 DAT	137
		42.07 g ai/100 L	Dip solution	0 DAT	279

CROP, TRIAL SITE	TEST ITEM	TREATMENT	SPECIMEN TYPE	SAMPLING TIME	FENTHION RESIDUE (mg/kg)
Eggplant ('Lucia'), SA, 2009	UTC	–	Whole fruit	–	< LOQ
	Fenthion	10.51 g ai/100 L	Whole fruit	0 DAT	1.88
		21.03 g ai/100 L	Whole fruit	0 DAT	1.07
		42.07 g ai/100 L	Whole fruit	0 DAT	1.30
	Fenthion	10.51 g ai/100 L	Dip solution	0 DAT	101
		21.03 g ai/100 L	Dip solution	0 DAT	159
		42.07 g ai/100 L	Dip solution	0 DAT	304
Eggplant ('Black Night'), Fredericksfield, Qld, 2009	UTC	–	Whole fruit	–	< LOQ
	Fenthion	10.51 g ai/100 L	Whole fruit	0 DAT	1.41
		42.07 g ai/100 L	Whole fruit	0 DAT	3.97
	Fenthion	10.51 g ai/100 L	Dip solution	0 DAT	93
		42.07 g ai/100 L	Dip solution	0 DAT	388
	Fenthion	10.51 g ai/100 L	Whole fruit	3 DAT	0.60
		42.07 g ai/100 L	Whole fruit	3 DAT	2.16
	Fenthion	10.51 g ai/100 L	Whole fruit	5 DAT	0.64
		42.07 g ai/100 L	Whole fruit	5 DAT	0.99
	Fenthion	10.51 g ai/100 L	Whole fruit	7 DAT	0.11
		42.07 g ai/100 L	Whole fruit	7 DAT	0.29

Data supplied for evaluation of permit application 8560 for fenthion on olives

The applicant provided one Australian residue trial on olives, conducted in Shepparton, Victoria[1]. The trial is summarised below.

Five trees (6 m between trees, 8 m between rows) of Vardale olives were treated with four treatments of fenthion at 41.25 g ai/100 L in spray volumes of 0.67 L/tree (about 140 L/ha; 1st application 64 DBH) and about 2.20 L/tree (about 470 L/ha; 2nd, 3rd and 4th applications). Applications were 14 days apart. The spray application was made with gas-powered spray equipment fitted with a Rega 062 nozzle fitted with a swirl plate. Samples of olives (2–5 kg) were collected 14 and 21 days after the last application. Samples were placed in a freezer within 2 hours of sampling.

1 Burns R (2003). Determination of fenthion residues in olives—field report. Serve-Ag Research.

Olives were analysed for fenthion residues by the Australian Government Analytical Laboratories (AGAL)[2], according to AGAL method number 'NR36 Multi-residues screening of food commodities by extraction, GPC clean-up and GCECD/NPD/MS determination with Procep large volume injector'.

Samples of the fruit were homogenised, mixed with 7.5 g of sodium sulfate and extracted with 30 ml of acetone, and ultra-sonicated. Dichloromethane and hexane were added and the mixture ultra-sonicated. The material was centrifuged into a TurboVap tube and evaporated to 1 ml. The solution was then made up to 10 ml with hexane. The solution was injected onto a GPC column and the fraction eluting between 23 and 35 minutes containing fenthion and the metabolites fenthion-sulfone and fenthion-sulfoxide was collected. The solution was analysed by GC-NPD with triphenyl-phosphate used as the internal standard.

Recoveries of fenthion from fortified olives were 88.6–113.7% (96.67% ± 9.60%, n = 7) for fortifications of 0.0479 mg/kg. Recoveries of fenthion from fortified olives were 98.7–119.5 % (106.49% ± 9.18%, n = 7) for fortifications of 0.1914 mg/kg.

Table A2.23: Residues of fenthion in olives following 4x foliar spray applications

LOCATION, YEAR	RATE (g ai/ha)	NO. SPRAYS, INTERVAL (DAYS)	PHI (DAYS)	COMMODITY ANALYSED	FENTHION (mg/kg)
Shepparton, Vic., 2003	Control	–	–	Fruit	–
	0.67 L/tree (1st app, equivalent to 0.28 g ai/tree, 41.25g ai/100 L)	4 (14 days)	14	Fruit	5.96
	2.2 L/tree (2,3 and 4th app, equivalent to 0.90 g ai/tree, 41.25 g ai/100 L)	4 (14 days)	21	Fruit	6.71 (6.46)

Residue data for olive fruit and oil were reported by the 1995 meeting of the JMPR. Data relevant to the Australian use pattern are presented below.

	APPLICATION			PHI	TOTAL FENTHION
TRIAL, YEAR	NO.	kg ai/ha	kg ai/100 L	(DAYS)	RESIDUES (mg/kg)
Italy, 1990	2	0.5 ground, full cover	0.05	0 14 28	1.7 0.92 0.87
Italy, 1990	2	0.5 ground, full cover	0.05	0 14 28	0.86 0.39 0.26
Italy, 1990	2	0.5 ground, full cover	0.05	0 14 28	0.93 0.84 0.36

2 Santhakumar M (2003). Determination of fenthion residues in olives—AGAL analytical phase study reference: VGLP17. AGAL.

The JMPR confirmed the previous MRL for olives as 1 mg/kg based on a PHI of 21 days (aerial) or 28 days (ground application). The JMPR recommended that the previously established MRL for Olive oil, Virgin (1 mg/kg) be replaced with an MRL of 3 mg/kg.

Trials carried out in Italy were reported in the literature by Cabras and colleagues.[3] Olive trees were bait sprayed 3–5 times with a mixture of protein bait and fenthion. Trees were sprayed with approximately 250 mL of solution containing 800 g ai/100 L. Based on tree densities of 150–200 trees/ha the application rate was equivalent to approximately 300–400 g ai/ha. Re-treatments intervals were 8 and 8 days in one trial and 24, 9, 15 and 23 days in the other. Samples of olives were collected 0 (1 hour), 11, 20, 34 and 54 days after the last treatment. Fenthion, its oxygen analogue and their sulfoxide and sulfone metabolites were determined by gas chromatography–nitrogen phosphorus detector (GC-NPD) following extraction with chloroform.

LOCATION, YEAR	RATE (g ai/100 L)	NO.	FENTHION*, mg/kg, AT DAYS AFTER APPLICATION				
			0	11	20	34	54
Imperia, Italy	800	3	1.98	1.25	1.18	0.99	0.66
Imperia, Italy	800	5	3.23	2.86	2.96	2.57	1.78

*Sum of fenthion, its oxygen analogue and their sulfoxide and sulfone metabolites, not corrected for differences in molecular weight.

Three further trials carried out in Italy were reported by Cavanna and Molinari.[4] In the 1990 trial, one plot was treated once at 500 g ai/ha and a second plot was treated twice at 500 g ai/ha with a 28-day re-treatment interval. In both cases samples of olives (2–3 kg) were collected 0 (4 hours), 14 and 28 days after the last treatment. In a 1992 trial, one plot was treated once at 500 g ai/ha and a second plot was treated twice at 500 g ai/ha with a 60-day re-treatment interval. In both cases samples of olives (2–3 kg) were collected 0 (4 hours), 28 and 60 days after the last treatment. In a 1993 trial, plots were treated three times at 90, 60 and 28 days before expected harvest. Samples of olives were collected at various times after the last treatment. Residues of fenthion and metabolites were determined by gas chromatography. Results were reported as averages for each trial so it was not possible to separate residue levels resulting from one or two applications (1990 and 1992 trials).

TRIAL, YEAR	APPLICATION			PHI (DAYS)	TOTAL FENTHION RESIDUES (mg/kg)
	g ai/ha	NO.	INTERVAL		
Italy, 1990	500	1–2	Not applicable or 28	0 14 28	0.653 0.390 0.142
Italy, 1992	500	1–2	Not applicable or 60	0 14 28	1.776 0.180 0.077

3 Cabras P, Garau VL, Melis M, Pirisi FM & Spanedda L (1993). Persistence and fate of fenthion in olives and olive products. Journal of Agricultural and Food Chemistry 41(12):2431–2433.

4 Cavanna S & Molinari GP (1998). Residues of fenthion and trichlorofon in olives and olive oil after olive tree treatments. Food Additives and Contaminants 15(5):518–527.

Italy, 1993	500	3	30, 32	0	1.542
				18	0.669
				28	0.401
				50	0.149
				60	0.081
				80	0.007
				90	0.015

It was stated that in the 1990 trial residues in fruit treated twice (28-day re-treatment interval) were twice as high as fruit treated once. However, there was no difference in final residues in olives when treated once or twice at a 60-day interval.

The following processing factors were determined for olives→crude oil:

PROCESSING FACTORS	REFERENCE
5.5, 3.3, 3.3, 5.2, 3.2	Cavanna & Molinari (1998).
3.6, 2.8, 2, 1.5, 6.6, 5.2, 6, 2.2, 3.2, 1.8	JMPR 1995 (various trials; includes Cabras et al. (1993).
Mean = 3.7, median = 3.3	

Data supplied for evaluation of permit application 2934 for fenthion on tamarillo

De Lima CPF (1999). Disinfestation of tamarillo fruit against Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae). Department of Agriculture, Western Australia, 15 July.

Following treatment of tamarillos with a fenthion dip at 500 ppm (60 seconds), a batch of pricked (15 pin pricks per fruit) and unpricked fruit was taken to determine the decline of residues on storage at 20°C for 0, 2, 4, and 8 days after dipping. Analysis of residues was by HPLC (LOQ 0.01 mg/kg).

Residues of fenthion (mg/kg) in tamarillos dipped with fenthion at 500 ppm for 60 seconds.

DAYS AFTER TREATMENT	PIN-PRICKED TAMARILLOS	WHOLE TAMARILLOS
0	0.09	0.07
2	0.06	0.05
4	0.06	0.07
8	0.07	0.06

* Residues in the untreated controls were < 0.01 mg/kg.

Residues in tamarillos were much less than the relevant MRL of 5 mg/kg for all times after dipping at 500 ppm for 60 seconds. This is not unexpected given the nature of the fruit's skin. There was no significant difference between intact fruit and fruit that were pin-pricked. The data demonstrate that dipping at the proposed rate (500 ppm for 60 seconds) will not lead to residues violations. Residues of fenthion in tamarillos are adequately covered by the current MRL of 5 mg/kg for assorted tropical and subtropical fruits—inedible peel.

ABBREVIATIONS

ADI	Acceptable Daily Intake (for humans)
AGAL	Australian Government Analytical Laboratories (now National Measurement Institute)
ai	active ingredient
APVMA	Australian Pesticides and Veterinary Medicines Authority
ARfD	Acute Reference Dose
Bw	Bodyweight
ChE	cholinesterase
Codex	FAO/WHO Codex Alimentarius Commission
DALA	days after last application
DAT	days after treatment
g	gram(g)
GAP	good agricultural practice
GC–MS	gas chromatography–mass spectrometry
GC–MS/MS	gas chromatography–tandem mass spectrometry
GC–NPD	gas chromatography–nitrogen phosphorus detector
GLP	good laboratory practice
GPC	gel permeation chromatography
ha	hectare
HAL	Horticulture Australia Limited
HPLC	high pressure liquid chromatography *or* high performance liquid chromatography
HR	high residue
JMPR	Joint FAO/WHO Meeting on Pesticide Residues
kg	kilogram
L	litre
LOQ	limit of quantitation (the level at which residues can be quantified)
m	metre
mg	milligram
mL	millilitre
MRL	maximum residue limit
NEDI	National Estimated Daily Intake
NESTI	National Estimated Short-Term Intake

NOEL	No Observable Effect Level
NSW	New South Wales
OCS	Office of Chemical Safety in the Australian Government Department of Health and Ageing
PHI	pre-harvest interval
ppm	parts per million
Qld	Queensland
SA	South Australia
SIM	selected ion monitoring
Tas.	Tasmania
UTC	untreated control
Vic.	Victoria
WHP	Withholding period