In processing

Cheminova reported processing studies on oranges, tomatoes, potatoes, cotton seed, maize and wheat, all with dimethoate EC formulations containing 480 g ai/l applied at about five times the GAP rate.

In the study on oranges (Rice, *et al.*, 1994) dimethoate (480 ai/l EC) was applied to orange trees with ground equipment in southern Florida in 1993 at 4.5 g ai/. About 1880 l of spray mix was applied per hectare so that the rate was about 8.5 kg ai/ha. Two applications were made with a 14-day retreatment interval. The PHI was 14 days. Oranges and processed commodities were analysed by the ABC method, with celite/charcoal used for clean-up. The residue on the unwashed oranges was 1.82 mg/kg dimethoate and 0.17 mg/kg omethoate. The water content of the oranges was 82.3%.

The oranges (400 kg) were processed by a standard commercial procedure within 18 days of harvest. The fruits were washed and then extracted with an FMC in-line juice extractor equipped with continuous water-spray nozzles. The juice stream passed continuously from the extractor through a modified FMC Model 35 finisher with a 0.05 cm screen to remove the frits. The oil/water emulsion was next passed over a shaker screen feeder to remove additional insoluble fibres (peel frits). The oil/water emulsion was allowed to stand for 5 or more hours and the lower water phase was drained and the concentrated oil emulsion centrifuged (laboratory scale) to yield cold-pressed oil. Peel from the extractor was collected in 200 l drums. A fraction was chopped in a Fitzpatrick comminuting machine, yielding wet pulp which was mixed with a lime slurry at the rate of 0.3% lime and passed through a press. The press cake was dried in a triple-pass direct-fired drier at 143°C.

The results are given in Table 57. Samples were stored frozen and analysed within 30 days.

Table 57. Residues of omethoate and dimethoate in the processed commodities of oranges treated with dimethoate (2 x 8.5 kg ai/ha, 14 day PHI, about 4x GAP rate).

Sample	Dimethoate, mg/kg, mean and (duplicates)	Control analysis		Omethoate, mg/kg, mean and (duplicates)	Control analyses		Processing factors
		Range, mg/kg No.	Recovery range and mean, %		Range, mg/kg No.	Recovery, %	
Oranges (unwashed)	1.44 (1.07; 1.82)	0.01–0.50 8	95–110 101	0.14 (0.12; 0.17)	0.01–0.50 8	82 –120 100	-
Oranges (washed)	1.50 (1.98; 1.03)			0.16 (0.20; 0.12)			1.0, 1.1
Juice	0.20 (0.20; 0.21)	0.01–0.50 7	102–110 107	0.03 (0.03; 0.03)	0.01–0.50 7	90–107 99	0.14; 0.21
Dried pulp	3.05 (3.18; 2.92)	0.01–0.50 7	69–84 79	0.24 (0.24; 0.24)	0.01–0.50 7	63–80 72	2.1; 1.7
Molasses	8.43 (8.14; 8.73)	0.01–0.50 7	70–100 87	0.88 (0.71; 1.06)	0.01–0.50 7	66–101 90	5.8; 6.3
Oil	0.28 (0.18; 0.29)	7 0.01–0.50	80 – 100 93	<0.01 (<0.01; <0.01)	0.01 – 0.50 7	65–120 79	0.19; <0.07

In a tomato processing study (Rice and Willliams, 1995) dimethoate was applied as a foliar spray 4 times to tomatoes at 2.8 kg ai/ha in the San Joaquin Valley, central California, USA. The retreatment interval and the PHI were 7 days. The applications were made with about 185 l of spray. Analyses were by the ABC method within 31 days of processing.

Control and treated tomatoes (340-350 kg) were treated by a simulated commercial process. They were washed in a four step sequence of flume and spray, then crushed and heated to 91°C (hot break). The hot crush mixture was filtered, yielding tomato juice and wet pomace. Part of the pomace was dried on trays in a dehydrator (30 hours at 68°C). A portion of the juice was canned (50 minutes at 115°C), and another condensed to purée in a vacuum evaporator. The percentage of National

Tomato Soluble Solids (NTSS) was determined and some of the purée was canned. Some was condensed to paste in a vacuum kettle, and a third portion (1.5 kg) was combined with other ingredients (1.7 kg) to prepare ketchup.

The results are given in Table 58. The tomatoes were processed within 24 hours of harvest and samples were analysed within 31 days of processing. The residues in all control samples were <0.01 mg/kg.

Table 58. Residues of dimethoate and omethoate in tomatoes and tomato processed commodities from the foliar application of dimethoate (2.8 kg ai/ha, 7 day PHI, 5 x GAP rate).

Sample	Dimethoate, mg/kg, mean and (duplicates)	Control analysis		Omethoate, mg/kg, mean and (duplicates)	Control analysis		
		Range, mg/kg No.	Recovery range and mean, %		Range, mg/kg No.	Recovery, %	Processing factors
Tomato	0.18	0.01–0.50 7	80–96 89	0.06	0.01–0.50 7	100–116 110	-
Juice	0.02	0.01 and 0.50 2	100; 97	<0.01	0.01 and 0.50 2	110; 104	0.11; 0.17
Wet pomace (64% water)	0.11	0.01 and 0.50 4	83–93 89	0.02	0.01 and 0.50 4	85–110 100	0.61; 0.33
Dry pomace (2.4% water)	0.10	0.01 – 0.50 7	70–104 87	0.01	0.01 – 0.50 7	70 –114 97	0.56; 0.17
Purée	0.30	0.01 and 0.50 2	80; 97	0.06	0.01 and 0.05 2	80; 114	1.7; 1
Paste	0.53	0.01 – 0.50 7	90–110 98	0.08	0.01–0.50 7	60–107 88	2.9; 1.4
Ketchup	0.33	0.01 and 0.50 2	90; 101	0.06	0.01 and 0.50 2	60; 106	1.8; 1

In a potato processing study by Rice *et al.* (1994) dimethoate was applied to potato plants in the Yakima Valley of Washington, USA, in 1993 at 2.8 kg ai/ha three times at 7-day intervals with ground equipment. About 190 l of water mixture was applied per hectare. The pre-harvest interval was 0 days. Samples from control and treated plots were analysed for dimethoate and omethoate by the ABC method. The potatoes were processed within 39 days of harvest, and the processed commodities extracted for analysis within 26 days of processing and then analysed within 6 days. All samples were stored frozen until analysis.

A 20-kg sample of potatoes was processed into chips by a process that simulated commercial practice, although they were not a variety that chippers would use. The potatoes were washed, culled, peeled with an abrasive peeler, and inspected to remove rotten potatoes and green tissue. A restaurant-style cutter was used to slice the potatoes into chips of about 1.6 mm thickness, which were placed in a tub of warm water to remove surface starch. The chips were deep-fried in fat at 177°C for 60–90 seconds, drained on a draining tray and salted. The commercial process uses a continuous deep fat fryer at 185°C for 60 seconds.

An additional sample was processed into granules (flakes) and wet peel. The variety, Russet Burbank Venhuizen, is a high-solids potato not suitable for the fresh market but very suitable for processing into granules. A 20-kg sample was tub-washed, sorted and steamed for 45 sec at 85 psi, then scrubbed with an abrasive peeler to remove the loosened peel. The collected peel was pressed and blended with cut trim waste to yield wet peel. About 18 kg of peeled potatoes were cut into 1.3 cm slabs with a restaurant-style slicer and spray-washed with cold water for 30 sec to remove free starch. The slices were cooked in a 120 l steam-jacketed kettle at 74°C for 20 minutes and cooled, and

a 15 kg aliquot steam-cooked at 100°C for 45 minutes. The potatoes were mashed in a Hobart grinder and mixed with food additives. The commercial process would add granules at this stage to absorb moisture and to separate individual potato cells, but this would dilute the processed sample with foreign granules. The granules were therefore prepared by taking a 1 kg sub-sample of the mashed potatoes and drying to 10% moisture on a fluid bed dryer at 93°C, yielding about 400 g. The dried sample was mixed with 1 kg of mashed potatoes and the fluid bed drying process was repeated. The addition and drying procedure was conducted a total of 5 times to produce 1.5 kg of dehydrated potato flakes. The flakes were screened with 30 and 60 mesh screens and the product retained by the 60 mesh was taken as the potato granule fraction.

Tubers, chips, granules and wet and dry peel were analysed by the ABC method. The method was validated for dimethoate and omethoate in tubers, dry peel and chips at 0.01, 0.05 and 0.50 mg/kg, and in granules and wet peel at 0.01–1.0 mg/kg. Concurrent recoveries were determined for tubers only. The results are shown in Table 59.

Table 59. Residues of omethoate and dimethoate in potatoes and their processed commodities from treatment with a dimethoate EC formulation at 3 x 2.8 kg ai/ha, 0-day PHI.

Sample	Dimethoate, mg/kg, mean and (duplicates)	Control analysis		Omethoate, mg/kg, mean and (duplicates)	Control analysis		Concentration factor (dimethoate)
		Range, mg/kg No.	Recovery range and mean, %		Range, mg/kg No.	Recovery, %	
Tubers (79% water)	0.09[1]	0.01; 0.1 concurrent	100; 100	<0.01	0.01; 0.10 concurrent	80; 119	-
Granules (5% water)	0.01	0.01-1.0 9	90-106 98	<0.01	0.01-1.0 9	101-130 112	0.12 (D)
Chips (4% water)	<0.01	0.01-0.50 7	91-120 100	<0.01	0.01-0.50 7	77-130 96	0.12 (D)
Wet peel (83% water)	0.02	0.01-1.0 9	85-97 89	<0.01	0.01-1.0 9	80-120 010	0.23 (D)
Dry peel (6% water)	0.06	0.01-0.50 7	80-93 83	<0.01	0.01-0.50 7	76-100 87	0.67 (D)

[1] Washing reduced the residue to 0.07 mg/kg

In a cotton seed processing study (Rice *et al.*, 1994) dimethoate was applied twice to cotton in Uvalde, Texas, USA in 1993 at a rate of 2.8 kg ai/ha (140 l/ha) with a 13-day retreatment interval. Cotton seed was harvested 14 days after the second application and processed 44 days after harvest. The processed commodities were extracted for analysis within 42 days of processing, and the seed within 80 days of harvest. All samples were stored frozen.

Processing was by procedures that simulated commercial practice. The cotton seed was saw ginned to remove the lint and the delinted seed mechanically cracked and screened to separate hulls from kernels. The kernels plus some residual hulls were heated, flaked and extracted with hexane. The spent flakes were treated with forced warm air to remove residual hexane. The crude oil was miscella-refined. About 52 kg cotton was ginned and delinted to produce 17.5 kg delinted seed which yielded 11.4 kg kernels and 5.52 kg hulls. Solvent extraction of 11 kg kernels gave 2.3 kg crude oil and 8.3 kg meal.

Samples were analysed by the ABC method. The method was validated for dimethoate and omethoate in meal, hulls and oil at 0.01–0.50 mg/kg and for dimethoate only in soapstock at 0.02 and 0.05 mg/kg. Recoveries of omethoate from soapstock were not acceptable. Concurrent recoveries were determined for cotton seed only. Results were reported for delinted but not for crude cotton seed; they should also . Data should have been provided for the crude seed. The results are shown in Table 60.

Table 60. Residues of dimethoate and omethoate in cotton seed and its processed commodities from the foliar application of a dimethoate EC formulation at 2 x 2.8 kg ai/ha with a PHI of 14 days.

Sample	Dimethoate, mg/kg, mean and (duplicates)	Control analysis		Omethoate, mg/kg, mean and (duplicates)	Control analysis		Concentration factor (dimethoate)
		Range, mg/kg No.	Recovery range and mean, %		Range, mg/kg No.	Recovery, %	
Delinted cotton seed	0.03	0.01 concurrent	90	<0.01	0.01 concurrent	80	-
Meal	0.04	0.01 – 0.50 7	78–90 83	<0.01	0.01 – 0.50 7	66–90 82	1.4
Hulls	0.08	0.01 – 0.50 7	83–90 87	<0.01	0.01 – 0.50 7	81 – 100 90	2.7
Crude oil	0.02	0.01 – 0.50 7	90–120 105	<0.01	0.01 – 0.50 7	99–140 116	0.67
Refined oil	<0.01	-	-	<0.01	-	-	0.34
Soapstock	<0.02	0.02 – 0.05 4	70-82 76	Not determined	0.03 – 0.05 4	28–40 31	0.67

In a maize processing study (Rice *et al.*, 1994). Dimethoate was applied three times to field corn in Danville, Iowa, USA in 1993, at 2.8 kg ai/ha (190 l/ha). The retreatment interval was 7 days and the PHI was 14 days.

The maize was both dry milled and wet milled by batch processes that resemble the commercial continuous processes. Whole corn grain samples were dried, aspirated and screened. For dry milling, the whole grain was conditioned to 20–22% moisture and impact-milled in a Ripple mill, then dried (70°C for 30 min) and passed over a 0.32 cm screen. The retained material was a mixture of large grits, germ and hull (bran) and was separated into the three components by aspiration and additional milling. Material that passed through the screen was processed into medium and small grits, coarse meal, meal and flour by sifting through a series of sieves. The germ was conditioned to 12% moisture, heated to 105°C, flaked and pressed in an expeller t liberate part of the crude oil. The residual presscake with oil was extracted 3 times with hexane at 60°C. The miscella was separated into crude oil and hexane at 90°C in a laboratory vacuum evaporator or rotary evaporator and the oil was heated to 176°C to remove hexane. The remaining presscake was air-dried and ground to form meal. The crude oil from the expeller was combined with the crude oil from the hexane extraction and refined according to AOCS method Ca9a52, yielding refined oil and soapstock.

A second batch of dried, aspirated and screened maize was processed by wet milling. The grain was steeped in water containing 0.2% sulfur dioxide at 54°C for 22–48 hours. The product was ground in a Bauer mill and floated in salt water to remove the germ. The germ was dried (90°C) to a final moisture content of 7–10%. The cornstock was ground twice in a mill containing 0.48 and 0.32 cm screens. Material retained by the 0.32 cm screen was collected and dried as bran. The cornstock passing through the 0.32 cm screen was further milled and screened. Material passing through a 43 micron screen was considered to be a starch and gluten mixture. The mixture was refrigerated to allow the starch and gluten to settle from the water. The starch and gluten were then separated by batch centrifugation. The germ fraction was adjusted to 12% moisture, heated to 105°C, flaked and pressed in an expeller. This produced crude oil and presscake. The presscake was treated as in dry milling.

The maize was stored frozen and processed within three months of harvest. The maize and processed commodities were analysed by the ABC method within 12 days of processing. The method was validated by the concurrent analysis of fortified control samples of grain, grits, meal, flour, starch and crude oil (produced by wet and dry milling). The results are shown in Table 61. Grain dust (aspirated grain fractions) was not analysed: it accounted for about 1% of the grain weight.

Table 61. Residues of dimethoate and omethoate in maize and its processed commodities from the foliar application of a dimethoate EC formulation at 2 x 2.8 kg ai/ha, 14 day PHI.

Sample	Dimethoate, mg/kg, mean and (duplicates)	Control analysis		Omethoate, mg/kg, mean and (duplicates)	Control analysis		Concentration factor (dimethoate)
		Range, mg/kg No.	Recovery range and mean, %		Range, mg/kg No.	Recovery, %	
Corn grain	0.06	0.01 – 0.50 7	80–92 87	<0.01	0.01 – 0.50 7	77–100 86	
Grits	0.02	0.01 – 0.50 7	87–94 90	<0.01	0.01 – 0.50 7	83 – 110 92	0.34
Meal	0.02	0.01 – 0.50 7	76–100 88	<0.01	0.01 – 0.50 7	74 – 100 88	0.34
Flour	0.02	0.01 – 0.50 7	91–100 96	<0.01	0.01 – 0.50 7	82 – 120 101	0.34
Starch	<0.01	0.01 – 0.50 7	80–90 86	<0.01	0.01 – 0.50 7	80–100 86	0.17
Crude oil (wet milled)	<0.01	0.01 – 0.50 7	78–90 87	<0.01	0.01 – 0.50 7	66–100 78	0.17
Refined oil (wet milled)	<0.01	Not determined		<0.01	Not determined		0.17
Crude oil (dry milled)	0.02	0.01, 0.02 2	120 90	0.03	0.01, 0.02 2	90 70	0.34 >3 (omethoate)
Refined oil (dry milled)	<0.01	Not determined		<0.01	Not determined		0.17

In a wheat processing study (Rice *et al.*, 1994) dimethoate was applied once at 2.1 kg ai/ha with ground equipment in 177 l water/ha. The PHI was 37 days and 50-kg samples were stored frozen until processed 48 days after harvest.

The batch processing was designed to mimic the continuous commercial process. Whole wheat samples were cleaned by aspiration and screening. The aspirated grain dust was separated by sieving but not analysed. The cleaned grain was adjusted to 16% moisture, milled and sieved. This produced bran (730 micron screen retention), middlings (390 and 240 micron screen retentions), low grade flour (132 micron screen retention) and patent flour (below 132 microns). The middlings were reduced to flour with a roller mill (4 passes, with sieving each time). The final material retained by the 390 and 240 micron screens was considered to be shorts and the fractions retained and passed by 132 micron filter were designated as before. The low grade flour and patent flour from the reducing steps were combined with the corresponding flours from the break steps. Conditioned wheat weighing 2.4 kg was processed into bran (3.5 kg), shorts (7.8 kg), low grade flour (6.1 kg), patent flour (3.1 kg) and middlings (1.8 kg).

The processed commodities were stored frozen for 21–64 days before analysis by the ABC method. Concurrent fortified control samples were also analysed. The results are shown in Table 62. Processing factors could not be calculated because none of the samples contained quantifiable residues.

Table 62. Residues of Dimethoate and Omethoate in or on Wheat Processed Commodities from the Foliar Application of a Dimethoate EC formulation at 2.1 kg ai/ha (5X), 37 day PHI (GAP = 0.42 kg ai/ha, 35 day PHI).

Sample	Dimethoate, mg/kg, mean and (duplicates)	Control analysis		Omethoate, mg/kg, mean and (duplicates)	Control analysis	
		Range, mg/kg No.	Recovery range and mean, %		Range, mg/kg No.	Recovery, %
Grain	<0.01	0.01-0.5 7	90-96 92	<0.01	0.01, 0.05	103-120 110

Sample	Dimethoate, mg/kg, mean and (duplicates)	Control analysis		Omethoate, mg/kg, mean and (duplicates)	Control analysis	
		Range, mg/kg No.	Recovery range and mean, %		Range, mg/kg No.	Recovery, %
Bran	<0.01	0.01, 0.05	90,86 concurrent	<0.01	0.01-0.5 7	100, 88 concurrent
Middlings	<0.01	0.01-0.5 7	80-99 93	<0.01	0.01-0.5 7	91-100 97
Shorts	<0.01	0.01-0.5 7	90-102 95	<0.01		92-120 106
Low grade flour	<0.01			<0.01	0.02-0.5 7	
Patent flour	<0.01	0.02-0.5 7	78-140 92 (sd 23)	<0.01	0.02-0.5 7	77-124 93 (sd 17)

Residues in the edible portion of food commodities

No information except as indicated in the supervised trials and processing studies.

RESIDUES IN FOOD IN COMMERCE OR AT CONSUMPTION

Australia provided monitoring data on residues in commodities in trade. An outbreak of papaya fruit fly in the Cairns district of Queensland in 1995 led to the enactment of a plant quarantine zone, with fruit exported from the zone being treated with dimethoate or fenthion post-harvest dips or sprays at 400 mg/l. Commodities from north Queensland delivered to the Brisbane markets were monitored for residues of dimethoate, fenthion and malathion. Analytical method PPQ-02 was used to determine dimethoate + omethoate, with a reporting limit of 0.01 mg/kg. The ranges of residues found is shown in Table 63. (Hamilton *et al.*, 1998).

Table 63. Monitoring data for dimethoate + omethoate in or on fruit and vegetables exported from the Queensland quarantine zone, 11/95–06/96, following disinfestation treatment with a dimethoate post-harvest spray or dip (400 mg/l).

Commodity	Total no. of samples	Number of samples with dimethoate ranges, mg/kg								
		≤0.01	>0.01 – ≤0.02	>0.02 – ≤0.05	>0.05– ≤0.1	>0.1 – ≤0.2	>0.2 – ≤0.5	>0.5 – ≤1.0	>1.0- ≤2.0	>2.0- ≤5.0
Avocado	96	61	1	9	7	16	2			
Banana	211	2	1	1		1	512	114	38	3
Carambola	15					1	2	1	7	4
Egg plant	7						4	1	2	
Lime	32					2	15	13	2	
Litchi	106	9			1	3	8	61	2	
Mango	121	59	5	7	14	10	21	4	1	
Passion fruit	60						17	22	18	3
Paw paw	247	9	3	83	96	44	9	1	2	
Pomelo	7	1		1	1	1	3			
Pumpkin	6			1	2	2	1			
Rambutan	16					1	2	4	8	1
Sapote	7				1	1	4	1		
Star apple	5					1	2	1	1	
Zucchini	8						1	1	6	

Dimethoate was included in the onion monitoring programme of the Australian National Residue Survey. Dimethoate and omethoate were absent (<0.01 mg/kg dimethoate, <0.05 mg/kg omethoate) from 47 samples taken in 1995 (Hamilton *et al.*, 1998).

Australia reported information on residues in food as consumed (Hamilton *et al.*, 1998). The 1994 Australian Market Basket Survey estimated the total dietary intake of certain pesticides for six different sub-populations. Simulated diets for these groups were developed from the National Dietary Surveys and each of the foods in the diet was prepared for consumption and analysed for dimethoate and other selected pesticides. Dimethoate was found in 9 commodities: apple juice (0.0013 mg/kg average, 0.02 mg/kg max), green beans (0.0004 mg/kg average, 0.01 mg/kg max), blueberries (0.0211 mg/kg average, 0.07 mg/kg max), white cabbage (0.0029 mg/kg average, 0.05 mg/kg max), sweet peppers (0.0029 mg/kg average, 0.03 mg/kg max), seeded grapes (0.0046 mg/kg average, 0.11 mg/kg max), lettuce (0.0031 mg/kg average, 0.03 mg/kg max), peaches (0.0611 mg/kg average, 0.22 mg/kg max) and pears (0.0042 mg/kg average, 0.10 mg/kg max). The estimated intake as a percentage of the ADI of 0.02 mg/kg bw/day ranged from 0.1% for adult males and boys and girls aged 12 years to 0.5% for toddlers aged 2 years. Details were not provided.

The Netherlands provided summary information on surveys for residues of dimethoate in food in commerce for the period 1994–1996. No details were provided. The information is given in Table 64.

Table 64. Residues of dimethoate in food in commerce in The Netherlands, 1994–1996.

Commodity	No. of samples analysed	Samples with residues <LOD (0.05 mg/kg)	Samples with Residues 0.05-1 mg/kg	Samples with residues >1 mg/kg	Mean residue, mg/kg
Grapefruit	301	299	2	0	<0.05
Tangerines	560	536	24	0	<0.05
Oranges	902	822	80	0	<0.05
Lemons	243	231	12	0	<0.05
Apples	1495	1464	31	0	<0.05
Cherries	252	234	18	0	<0.05
Peaches	252	248	4	0	<0.05
Nectarines	221	216	5	0	<0.05
Plums	437	437	0	0	<0.05
Grapes	667	619	46	2	<0.05
Strawberries	2378	2371	7	0	<0.05
Blackberries	244	243	0	1	<0.05
Currants (red, black, white)	450	443	7	0	<0.05
Avocados	125	123	2	0	<0.05
Kiwi	223	221	2	0	<0.05
Litchis	35	32	3	0	<0.05
Mangoes	191	188	2	1	<0.05
Passion fruit	40	40	0	0	<0.05
Other fruits and products	385	373	12	0	<0.05
Radishes	1010	1008	2	0	<0.05
Garlic	35	35	0	0	<0.05
Onions (small)	97	95	2	0	<0.05
Tomatoes	1108	1108	0	0	<0.05
Peppers	1525	1519	6	0	<0.05
Cucumbers	951	947	4	0	<0.05
Gherkins/pickle	43	42	1	0	<0.05
Courgettes	296	203	3	0	<0.05
Melons	390	382	8	0	<0.05
Watermelons	19	18	7	0	<0.05
Broccoli	154	153	1	0	<0.05
Cauliflower	348	347	1	0	<0.05
Chinese cabbage	297	287	10	0	<0.05
Other leaf cabbage	99	98	1	0	<0.05
Kohlrabi	31	31	0	0	<0.05
Lambs lettuce	268	267	1	0	<0.05
Lettuce	3306	3284	20	2	<0.05
Iceberg lettuce	471	445	26	0	<0.05

Commodity	No. of samples analysed	Samples with residues <LOD (0.05 mg/kg)	Samples with Residues 0.05-1 mg/kg	Samples with residues >1 mg/kg	Mean residue, mg/kg
Endive	1137	1128	9	0	<0.05
Spinach	440	437	1	2	0.09
Watercress	10	9	1	0	<0.05
Witloof (chicory)	457	428	29	0	0.14
Parsley	368	365	3	0	<0.05
Other herbs	148	143	5	0	<0.05
Beans (fresh, with pod)	617	581	36	0	<0.05
Beans (fresh, without pod)	39	35	4	0	<0.05
Peas (fresh, with pod)	46	45	1	0	<0.05
Peas (fresh, without pod)	123	114	8	1	<0.05
Other legumes (fresh)	8	7	1	0	<0.05
Celery	233	230	3	0	<0.05
Fennel	52	52	0	0	<0.05
Leek	441	440	1	0	<0.05
Other stem vegetables	341	338	3	0	<0.05
Mushrooms	384	383	1	0	<0.05
Beans	2	1	1	0	<0.05
Other pulses (dried)	42	41	1	0	<0.05
Other arable products	699	692	7	0	<0.05
Maize	37	37	0	0	<0.05

The Netherlands also supplied similar information on residues of omethoate in food in commerce for the same period (Table 65).

Table 65. Residues of omethoate in food in commerce in The Netherlands, 1994–1996.

Commodity/MRL	No. of samples analysed	Samples with residues <LOD (0.05 mg/kg)	Samples with Residues 0.05-1 mg/kg	Samples with residues >1 mg/kg	Mean residue, mg/kg
Apples/0.2	1495	1491	3	1	<0.02
Cherries/0.4	252	251	1	0	<0.02
Grapes/0.1	667	660	5	2	<0.02
Strawberries/0.1	2378	2378	0	0	<0.02
Currants (red, black, white)/0.1	450	450	0	0	<0.02
Other fruits and products/0.2	385	384	1	0	<0.02
Tomatoes/0.2	1108	1108	0	0	<0.02
Peppers/0.2	1525	1519	6	0	<0.05
Cauliflower/0.2	348	347	1	0	<0.02
Chinese cabbage/0.2	297	296	1	0	<0.02
Kohlrabi/0.2	31	30	1	0	<0.02
Lettuce/0.2	3306	3305	1	0	<0.02
Iceberg lettuce/0.2	471	470	1	0	<0.02
Endive/0.2	1137	1136	1	0	<0.02
Spinach/0.4	440	439	0	1	<0.02
Witloof (chicory)/0.4	457	450	6	1	<0.02
Beans (fresh, with pod)/0.2	617	615	2	0	<0.02
Beans (fresh, without pod)/0.2	39	38	0)?)	0	<0.02
Peas (fresh, without pod)/0.2	123	121	1	1	<0.02

NATIONAL MAXIMUM RESIDUE LIMITS

National maximum residue limits were not reported by the DTF or Cheminova. National MRLs reported by the governments of Australia, Germany and The Netherlands are shown below.

Country	Commodity	MRL, mg/kg	Residue definition
DIMETHOATE (027)			
Australia	Cereal grains	0.05	Dimethoate + Omethoate, expressed as dimethoate (0.05 is the approximate LOD)
	Edible offal (mammalian)	0.05	
	Eggs	0.05	
	Fruiting vegetables, cucurbits	2	
	Fruits (except strawberry, litchi, peaches)	2	
	Litchi	5	
	Lupin (dry)	0.5	
	Lupin, forage	1	
	Meat (mammalian)	0.05	
	Milks	0.05	
	Oilseed (except peanut)	0.1	
	Peaches	T5	
	Peanut	0.05	
	Peppers sweet (capsicums)	1	
	Poultry, edible offal of	0.05	
	Poultry meat	0.05	
	Strawberry	5	
	Tomato	1	
	Vegetables (except lupin, dry; peppers, sweet; tomato)	2	
Germany	Vegetable	1	Dimethoate
	Fruit	1	
	Cereals	0.2	
	Tea	0.2	
	Other foods of plant origin	0.05	
The Netherlands	Fruit	1	Dimethoate (parent compound)
	Vegetables	1	
	Tea	0.2	
	Other food commodities	0.05	(0.05 is the LOD)
OMETHOATE (055)			
Australia	Cereal grains	0.05	Omethoate (0.05 is the approximate LOD)
	Edible offal (mammalian)	0.05	
	Eggs	0.05	
	Fruits	2	
	Legume animal feeds (fresh weight)	20	
	Lupin (dry)	0.1	
	Lupin forage	0.5	
	Meat (mammalian)	0.05	
	Milks	0.05	
	Miscellaneous fodder and forage crops (fresh weight)	20	
	Oilseed	0.05	
	Peppers, sweet (capsicums)	1	
	Poultry, edible offal of	0.05	
	Poultry meat	0.05	
	Straw, fodder (dry, and hay of cereal grains and other grass-like plants	20	
	Tomato	1	
	Vegetables (except lupin; peppers, sweet; tomato)	2	
Germany	Hops	10	
	Artichokes	0.4	
	Witloof	0.4	
	Spices	0.4	
	Cherries	0.4	
	Oilseeds	0.4	
	Spinach	0.4	
	Remaining vegetables	0.2	

Country	Commodity	MRL, mg/kg	Residue definition
	Remaining fruits	0.2	
	Small fruits and berries, except grapes	0.1	
	Leek	0.1	
	Tea	0.1	
	Root and tuber vegetable	0.1	
	Bulb vegetable	0.1	
	Other foods of plant origin	0.05	
The Netherlands	Cherries	0.4	Omethoate (parent compound)
	Table and wine grapes	0.1	
	Strawberries (other than wild)	0.1	
	Other small fruit and berries (other than wild)	0.1	
	Other fruit	0.2	
	Root and tuber vegetables	0.1	
	Onions	0.1	
	Spinach	0.4	
	Witloof	0.4	
	Leeks	0.1	
	Globe artichokes	0.4	
	Other vegetables	0.2	
	Tea	0.1	
	Other food commodities	0.02	(0.02 is the limit of determination)
FORMOTHION (042)			
Germany	Citrus fruit	0.2	Formothion
	Vegetable	0.1	
	Remaining fruit	0.1	
	Tea, tealike products	0.05	
	Other foods of plant origin	0.01	
The Netherlands[1]	Citrus fruit	0.2	Formothion
	Other fruit	0.1	
	Vegetables	0.1	
	Cereals	0.05	(0.05 is the limit of determination)
	Other food commodities	0 (0.05)	

[1]Not authorized for use in this country

APPRAISAL

Dimethoate, *O,O*-dimethyl *S*-methylcarbamoylmethyl phosphorodithioate, is a contact and systemic insecticide typically applied as an emulsifiable concentrate (EC) diluted in water at 0.3 – 0.7 kg ai/ha. The toxicology was reviewed in 1996 and an ADI of 0.002 mg/kg bw was allocated to the sum of dimethoate and omethoate, expressed as dimethoate. Omethoate, *O,O*-dimethyl *S*-methylcarbamoylmethyl phosphorothioate, is a metabolite of dimethoate and a systemic pesticide. Since 1986, the JMPR has estimated separate maximum residue levels for dimethoate and omethoate. Formothion, *S*-[formyl(methyl)carbamoylmethyl] *O,O*-dimethyl phosphorodithioate, is metabolized by plants to dimethoate and omethoate. No Codex MRLs or draft MRLs exist for formothion. Its toxicology was last reviewed in 1969 but no ADI was allocated.

The three compounds are now re-evaluated within the CCPR Periodic Review Programme, but as no information on formothion was submitted the evaluation refers only to dimethoate and omethoate.

Animal metabolism

Metabolism studies were reported for rats, goats and chickens. In the rat studies, three metabolites were identified in urine: *O,O*-dimethyl hydrogen phosphorothioate (7%), *O,O*-dimethyl hydrogen phosphorodithioate (25%) and dimethoate carboxylic acid (36%).

Leghorn chickens were given oral doses (0.9 mg/kg bw/day) of [*methoxy*-^{14}C]dimethoate for 7 days. The radioactive residue levels in the liver, muscle, fat, egg yolk (last day) and egg white (last day) were 0.64, 0.09, 0.038, 0.34 and 0.15 mg/kg respectively. The liver residue (0.82 mg/kg as dimethoate) was shown to consist mainly of phosphorylated natural products (33% of the TRR), omethoate (10% of the TRR) and dimethoate carboxylic acid (16% of the TRR). Phosphorylated natural products were significant proportions of the residue in muscle (36-46% of the TRR), egg white (50%), and egg yolk (35%). Dimethoate was not found in any of the samples. Omethoate was absent from muscle and fat, but found in egg whites at 3% of the TRR (0.004 mg/kg) and liver after protease treatment.

Dimethoate labelled on the methoxy carbons was administered orally to goats once daily for 3 consecutive days at 1.6 mg/kg bw/day. The concentrations of ^{14}C as dimethoate were liver 1.2 mg/kg, kidney 0.15 mg/kg, muscle 0.07 mg/kg, fat 0.05 mg/kg, and milk (48–60 h) 0.23 mg/kg. Much of the residue was characterized as phosphorylated natural products, 35% of the TRR in the liver, 32% in the kidneys, 53% in the muscle, and 53% in the milk. Dimethoate was not found in any sample and omethoate was found only in the liver (0.12 mg, 10% of the TRR) after protease treatment of the extraction residue. Urine was shown to contain dimethoate carboxylic acid, dimethyl hydrogen phosphorothioate and dimethyl hydrogen phosphate. The metabolism in both poultry and ruminants is consistent with the formation of the sulfoxides of omethoate and dimethoate carboxylic acid. The sulfoxides would react with nucleophiles, leading to phosphorylated natural products.

The Meeting concluded that the metabolism of dimethoate and omethoate in animals is adequately understood.

Plant metabolism

The metabolism of [^{32}P]dimethoate in sugar beet, maize, cotton, peas, potatoes and beans has been reported. The reports were summaries which did not provide the customary detail. Generally, the main components of the radiolabelled residue were dimethoate, omethoate, dimethoate carboxylic acid, dimethyl hydrogen phosphate and *O,O*-dimethyl hydrogen phosphorodithioate, indicating oxidation to omethoate, omethoate carboxylic acid and dimethoate carboxylic acid, and cleavage of the P-S linkage either before or after oxidation. A difference from animal metabolism is that the sulfoxide is apparently not formed.

Dimethoate is water-soluble and considerable translocation of foliar dimethoate might be expected. The metabolism studies with maize, cotton, potatoes and peas indicated the extent of penetration of residues into the leaves, but no detailed study on residue translocation was reported.

The Meeting concluded that the plant metabolism studies were incomplete, both because a detailed study was not provided and because translocation was not adequately addressed.

Environmental fate

Studies were reported on confined rotational crops, degradation, dissipation and mobility in soil, adsorption and desorption, photodegradation on soil, and aquatic dissipation.

In the confined rotational crop study, soil was treated with [^{14}C]dimethoate at a rate of 0.56 kg ai/ha. Lettuce, turnips and wheat were planted after 30 and 120 days and grown to maturity. The radioactive residues were highest in the 30-day plantings, ranging from 0.008 mg/kg as dimethoate in

turnip roots to 0.045 mg/kg in wheat straw. A substantial proportion of each crop sample (30-60% of the TRR) was characterized as polar compounds or polar hydroxy compounds. The crops planted after 120 days showed very low radioactive residues, ranging from 0.001 mg/kg in turnip roots to 0.02 mg/kg in wheat straw.

The Meeting concluded that inadvertent residues in rotational crops would not be significant, that the low residue levels consisted mainly of polar metabolites and that dimethoate and omethoate concentrations under field conditions would be below 0.01 mg/kg, a typical lower limit of quantification.

When the degradation of [^{14}C]dimethoate in soil under aerobic and anaerobic conditions was studied its half-life in sandy loam soil under aerobic conditions was 2.4 days, with two products identified: dimethyl hydrogen phosphorothioate and *O*-demethyl-dimethoate. Radioactive carbon dioxide accounted for 75% of the applied radioactivity after 180 days, indicating mineralization as the ultimate fate. The half-life of dimethoate under anaerobic conditions (after two days of aerobic conditioning) was 4 days. The same products were identified.

Soil dissipation studies in the UK and the USA showed that dimethoate does not migrate readily below the top 15 cm and that the half-life is 2–4 days. In other studies half-lives of dimethoate in soil were 9.8 days in bean plots, 6.0 days in grape plots and 7.8 days in bare soil. A lysimeter test in Germany showed that radiolabelled dimethoate had little tendency to migrate downward through the soil, with 17% of the recovered radioactivity in the top 12 cm.

The Meeting concluded that dimethoate was degraded at a moderate rate in soil with a half-life of about 4 days, and that it migrates only slowly under normal agricultural conditions.

Leaching studies were reported with four types of soil. Dimethoate is readily leached, with the rate of leaching decreasing with increasing loam content of the soil, but leaching is offset by the short half-life in soil.

The half-lives of dimethoate in two water/sediment systems were 13 and 17 days. The only identified product was demethyl-dimethoate.

In a study of the photodegradation of dimethoate on soil the half-life in sunlight was 10 days, but the half-life in the dark was 8 days. The Meeting concluded that photodegradation was not significant.

Methods of residue analysis

Adequate methods exist for data collection, monitoring, and the enforcement of MRLs. The methods are similar and involve maceration of the substrate with solvent, typically acetone/water, and extraction of the (concentrated) macerate with chloroform or methylene chloride. Extracts are sometimes cleaned up on a column of celite or Florisil or by GPC. Some Australian methods use sweep co-distillation with ethyl acetate after the chloroform extraction, but this step destroys omethoate. The final extracts are analysed on a gas chromatograph equipped with a capillary column and a flame photometric detector (FPD). The typical lower limits of quantification are 0.01 mg/kg for both dimethoate and omethoate.

Extensive recovery data were presented for the most common methods.

Stability of stored analytical samples

The stabilities of dimethoate and omethoate on fortified analytical samples of tubers, oranges, sorghum grain, sorghum forage and cotton seed during frozen storage were determined. The Meeting concluded that dimethoate was stable on all these commodities for at least 1.7 years and that

omethoate was also stable on all of them with the possible exception of cotton seed, from which a 20% loss may have occurred during the first 5 months with no subsequent decrease.

Definition of the residue

On the basis of the metabolism of dimethoate in plants and animals, the conclusions of the 1996 JMPR on the toxicology, the available analytical methods and the lack of significant data on omethoate *per se*, the Meeting concluded that the residue for compliance with MRLs should be defined as dimethoate. The MRLs for omethoate should be considered for withdrawal because no data were reported to support omethoate MRLs. For the estimation of dietary intake the residue is based on the sum of dimethoate and omethoate, each considered separately.

Residues resulting from supervised trials

Supervised trials were reported on oranges (post-harvest), apples, pears, cherries, plums, blueberries, strawberries, grapes, currants, avocados (post-harvest), litchis (post-harvest), chives, leeks, Brussels sprouts, cabbages, cauliflowers, broccoli, kohlrabi, cucumbers (post-harvest), zucchini (post-harvest), rockmelons (post-harvest), watermelons (post-harvest), tomatoes, sweet peppers, kale, spinach, chard, lettuce, peas, French beans, mung beans, potatoes, turnips, sugar beet, carrots, long radishes, asparagus, sorghum, barley, maize, wheat and witloof chicory.

Oranges. Post-harvest trials were reported from Australia. Only one residue was reported at the specified 0-day post-treatment holding period. The data were insufficient to estimate a maximum residue level or STMR. The Meeting recommended withdrawal of the existing CXLs for dimethoate and omethoate in citrus fruits.

Pome fruit (apples and pears). Supervised field trials on apples in The Netherlands and Germany were reported. Two trials in The Netherlands and 10 in Germany complied with GAP for apples and pears (3 x 0.02 kg ai/hl (0.30 kg ai/ha), 21-day PHI, and 3 x 0.04 kg ai/hl (0.6 kg ai/ha), 21-day PHI respectively). Two trials were reported with the use of omethoate on apples in The Netherlands, with residues as high as 0.1 mg/kg, but this is insufficient for the estimation of residues from the use of omethoate *per se*. Four supervised field trials in Germany with foliar application of dimethoate to pears complied with GAP. The residues of dimethoate in apples and pears in rank order were 0.01, 0.03, <0.05 (5), 0.06, 0.07, 0.08, 0.10, 0.14, 0.15, 0.16, 0.26 and 0.30 mg/kg. The residues of omethoate from the use of dimethoate were 0.04, <0.05 (6), 0.05 (2), 0.06 (2), 0.07, 0.08 and 0.13 mg/kg. The Meeting estimated a maximum residue level for dimethoate of 0.5 mg/kg and an STMR of 0.065 mg/kg, and an STMR for omethoate of 0.05 mg/kg.

Cherries. In four supervised trials in the USA the application rate was about 7.7 times the GAP rate. Ten trials in Germany complied with GAP (3 x 0.04 kg ai/hl (0.6 kg ai/ha), 21-day PHI). The residues of dimethoate were <0.02, <0.05, <0.05, 0.03, 0.06, 0.06, 0.08, 0.13, 0.19 and 1.5 mg/kg, and those of omethoate were <0.01, 0.03, 0.05, 0.11, 0.27, 0.27, 0.28, 0.28, 0.28 and 0.46 mg/kg. The Meeting estimated a maximum residue level for dimethoate of 2 mg/kg, and STMRs for dimethoate of 0.06 mg/kg and for omethoate of 0.27 mg /kg.

Plums. Four replicate trials in The Netherlands could not be used to estimate a maximum residue level because the PHI of 14 days was less than the GAP 21-day PHI and one of the trials showed a significant residue at 14 days. Twenty-three trials according to GAP (3 x 0.04 kg ai/hl (0.6 kg ai/ha), 14-day PHI) were reported from Germany, with residues of dimethoate of <0.02, <0.05 (6), 0.05, 0.06, 0.07, 0.09, 0.10, 0.11, 0.12 (2), 0.13 (2), 0.15, 0.24, 0.28, 0.36, 0.46 and 0.75 mg/kg and of omethoate of <0.02, <0.05 (10), 0.05 (3), 0.07, 0.08, 0.12 (2), 0.14, 0.17 and 0.22 mg/kg. The Meeting estimated a maximum residue level for dimethoate of 1 mg/kg , an STMR for dimethoate of 0.10 mg/kg and an STMR for omethoate of 0.05 mg/kg.

Blueberries. Supervised field trials were reported from the USA. There is no current GAP.

Strawberries. Three varieties were treated at various rates in replicate plots in Australia, but the combined residue of dimethoate and omethoate was measured and only 3 residues were from GAP conditions (0.30 kg ai/ha, 1-day PHI). There were insufficient data to estimate a maximum residue limit or STMR and the Meeting recommended withdrawal of the CXL for strawberry.

Grapes. Supervised field trials were reported from France and Germany, but without corresponding GAP. GAP for The Netherlands is 3 x 0.02 kg ai/hl (0.24-0.30 kg ai/ha), 21- or 28-day PHI. GAP for Hungary is 0.04 kg ai/hl (0.32 kg ai/ha) with a 14-day PHI. Seven trials in France were close to these conditions. The residues were 0.11, 0.18, 0.21, 0.48, 0.53, 0.89 and 1.2 mg/kg of dimethoate and <0.05, <0.05, 0.08, 0.11, 0.11, 0.14, 0.19 mg/kg of omethoate. The Meeting estimated a maximum residue level for dimethoate of 2 mg/kg, and STMRs for dimethoate of 0.48 mg/kg and for omethoate of 0.11 mg/kg.

Currants. Supervised field trials were carried out in Germany but no GAP was reported. GAP for The Netherlands is 3 x 0.24 kg ai/ha, 21-day PHI, but none of the German trials complied with it. The Meeting recommended withdrawal of the existing CXL for currant, black.

Sub-tropical fruits with inedible peel. Two supervised trials each on avocados, mangoes and litchis, post-harvest dips or high-volume sprays, were reported from Australia. The residues belonged to different populations and could not be combined for evaluation. There were therefore insufficient data to estimate maximum residue levels or STMRs.

Leeks. One supervised trial in Germany complied with GAP for The Netherlands, assuming an application of 1000 l of spray solution per ha. One trial was inadequate to estimate a maximum residue level or STMR.

Onions. Seven supervised field trials according to GAP (2 x 0.24 kg ai/ha, 14-day PHI) were reported from Germany. The residues were <0.01, 0.01, <0.02, ≤0.02, 0.04, <0.05 and <0.05 mg/kg of dimethoate and <0.01, <0.01, <0.02, <0.02, <0.02, <0.05 and <0.05 mg/kg of omethoate. The Meeting estimated a maximum residue level of 0.05* mg/kg for dimethoate and STMRs of 0.02 mg/kg for both dimethoate and omethoate.

Cauliflowers. Nine field trials on cauliflowers in Germany were not according to GAP. Eight trials in the UK complied with UK GAP for brassica vegetables (6 x 0.40 kg ai/ha, 7-day PHI). The residues were 0.02, 0.02, 0.03, 0.04, 0.09, 0.09, 0.11 and 0.34 mg/kg of dimethoate and <0.01 (8) and 0.01 mg/kg of omethoate. The Meeting estimated a maximum residue level of 0.5 mg/kg for dimethoate and STMRs of 0.065 mg/kg for dimethoate and 0.01 mg/kg for omethoate.

Broccoli. Only one supervised trial was reported, which did not comply with GAP. A maximum residue level or STMR could not be estimated.

Brussels sprouts. Four supervised field trials in Germany (GAP 0.24 and 0.36 kg ai/ha, 14-day PHI), three in The Netherlands (GAP 0.2 kg ai/ha repeated, 21-day PHI), one in the USA (GAP 6 x 1.12 kg ai/ha, 10-day PHI) and eight in the UK (GAP 6 x 0.40 kg ai/ha, 7-day PHI) complied with national GAP. The residue in the US trial (3.12 mg/kg) was an outlier and was not included. In one of the UK trials there was an unacceptable concentration of residue in the control. In the remaining trials the residues of dimethoate were 0.005, 0.009, 0.03, <0.05, <0.05, 0.05, 0.06, 0.07, 0.08, 0.10, 0.11, 0.17, 0.21 and 0.46 mg/kg, and those of omethoate were <0.01, <0.01, <0.01, 0.01, 0.02, 0.03, 0.03, 0.04, 0.07, 0.08, 0.09, 0.16, 0.30 mg/kg (omethoate was not determined in one of the German trials). The Meeting estimated a maximum residue level of 1 mg/kg for dimethoate and STMRs of 0.065 mg/kg for dimethoate and 0.03 mg/kg for omethoate.

Cabbage. Twelve supervised field trials on cabbages in Germany (8 Savoy and 4 head) complied with GAP (0.4 kg ai/ha, 42-day PHI or 2 x 0.24 kg ai/ha, 14-day PHI), as did eight on head cabbages in the

UK (6 x 0.40 kg ai/ha, 7-day PHI) and two in The Netherlands (0.2 kg ai/ha repeated, 21-day PHI). The residues in head cabbages were in two population groups, those in Germany and The Netherlands ranging from <0.01 to 0.07 mg/kg dimethoate and <0.01 to 0.02 mg/kg omethoate and those in the UK ranging from 0.04 to 1.2 mg/kg dimethoate and <0.01 to 0.64 mg/kg omethoate. In the UK trials only one residue (of omethoate) was below the LOD. In the German and Dutch trials, 4 of 6 dimethoate residues and 4 of 5 omethoate residues were below the LOD. The residues of dimethoate in the population with highest residue levels (UK) were 0.04, 0.07, 0.14, 0.25, 0.67, 0.82, 0.99 and 1.2 mg/kg, and those of omethoate in the same population were <0.01, 0.02, 0.04, 0.05, 0.28, 0.35, 0.63 and 0.64 mg/kg. The Meeting estimated a maximum residue level of 2 mg/kg for dimethoate and STMRs of 0.46 mg/kg for dimethoate and 0.165 mg/kg for omethoate on head cabbages except Savoy cabbage.

The residues of dimethoate on Savoy cabbages in Germany were <0.01 (2), <0.02 (4) and <0.05 (2) and of omethoate <0.01 (2), <0.02 (2), 0.13, 0.17, 0.31 and 0.66 mg/kg. The Meeting estimated maximum residue levels of 0.05* mg/kg for dimethoate and STMRs of 0.02 mg/kg for dimethoate and of 0.075 mg/kg for omethoate on Savoy cabbage.

Kohlrabi. Two supervised trials in Germany complied with UK GAP but were insufficient to estimate a maximum residue level or STMR.

Cucumbers, zucchini, cantaloupes. A single trial on each in Australia with post-harvest treatment was reported. One trial is insufficient for the estimation of a maximum residue level or STMR.

Watermelons. Two post-harvest trials in Australia at maximum GAP (400 mg/l dip, 0-day post-treatment interval) were inadequate for the estimation of a maximum residue level or STMR.

Tomatoes. Six post-harvest trials in Australia were according to GAP (400 mg dimethoate/l solution dip, 7-day post-treatment interval), but only dimethoate was determined. Fourteen trials in Germany complied with GAP (3 foliar applications, 0.24, 0.36, 0.48 kg ai/ha or 0.04 kg ai/hl, 3-day PHI). The 20 dimethoate residues in rank order were 0.01, 0.05 (2) 0.06 (2), 0.08, 0.12, 0.15, 0.19, 0.20, 0.22, 0.24, 0.26 (2), 0.31, 0.34, 0.41, 0.42, 0.80 and 1.3 mg/kg. The 14 omethoate residues were 0.01, 0.03 (3), 0.04, <0.05, 0.05 (3), 0.06, 0.09, 0.13, 0.14 and 0.32 mg/kg. The Meeting estimated a maximum residue level of 2 mg/kg for dimethoate and STMRs of 0.21 mg/kg for dimethoate and 0.05 mg/kg for omethoate.

Sweet peppers. Three trials in Australia with post-harvest dip treatment of sweet peppers were according to the Queensland GAP of 0.04 kg dimethoate per 100 l of dipping solution with no specified holding period. The Meeting concluded that three trials were inadequate for the estimation of maximum residue levels or STMRs and recommended withdrawal of the existing CXL for peppers.

Kale. Eight supervised field trials were carried out in Germany, but no relevant GAP was reported. The Meeting could not evaluate the data and recommended withdrawal of the existing CXL.

Chard, leaf lettuce. One trial in Germany on each crop was reported but without relevant GAP. The data were inadequate.

Head lettuce. Twelve supervised trials reported from Germany complied with GAP (2 x 0.24 kg ai/ha, 21-day PHI). One trial was not evaluated because the total residues increased substantially from 7 to 14 days and the dimethoate/omethoate ratio at 14 and 21 days was quite different from that in the other trials. The residues of dimethoate were <0.02 (7), <0.05 (2), 0.09 and 0.24 mg/kg, and those of omethoate were <0.02 (3), 0.02, 0.03, 0.03, <0.05, <0.05, 0.05, 0.06 and 0.10 mg/kg. The Meeting estimated a maximum residue level of 0.5 mg/kg for dimethoate and STMRs of 0.02 mg/kg for dimethoate and 0.03 mg/kg for omethoate.

Spinach. Two of four supervised trials in Germany complied with the GAP of The Netherlands (0.20 kg ai/ha, 21-day PHI). The Meeting considered the data inadequate and recommended the withdrawal of the existing CXL.

Peas. Supervised trials according to GAP were reported from Denmark (2 trials; GAP 0.32 kg ai/ha, 14-day PHI); the UK (3 trials; GAP 6 x 0.34 kg ai/ha, 14-day PHI); Germany (3 trials according to UK GAP); The Netherlands (2 trials; GAP 3 x 0.20 kg ai/ha, 21-day PHI) and the USA (4 trials; GAP 0.19 kg ai/ha, 0-day PHI). The dimethoate residues were <0.01, 0.018, 0.026, 0.027, 0.03, 0.04, 0.04, 0.09, 0.19, 0.27, 0.36, 0.44, 0.50 and 0.64 mg/kg, and the omethoate residues <0.01, <0.01, 0.015, 0.02 (5), 0.022, 0.026, 0.03, 0.04, 0.052 and 0.20 mg/kg. The Meeting estimated a maximum residue level of 1 mg/kg for dimethoate and STMRs of 0.065 mg/kg for dimethoate and 0.02 mg/kg for omethoate.

Beans. Three trials on French beans in Germany were not according to GAP. A single trial on mung beans in the USA complied with GAP (0.56 kg ai/ha, 0-day PHI). The data on beans were inadequate.

Potatoes. Nine trials in Germany (GAP 0.24 kg ai/ha, 14-day PHI) and one each in the UK (GAP 2 x 0.34 kg ai/ha), The Netherlands (GAP 4 x 0.20 kg ai/ha, 21-day PHI) and Denmark (GAP 0.30–0.32 kg ai/ha, 14-day PHI) were according to national GAP. The residues of dimethoate were <0.01 (6), 0.01, <0.02 (4) and 0.02 mg/kg and those of omethoate were <0.01 (6), 0.01, <0.02 (4) and 0.02 mg/kg. The Meeting estimated a maximum residue level of 0.05 mg/kg for dimethoate and STMRs of 0.01 mg/kg each for dimethoate and omethoate.

Turnips, turnip greens. Seven trials in the USA complied with GAP (0.28 kg ai/ha, 14-day PHI). The residues of dimethoate and omethoate in the roots were <0.1 mg/kg in all the samples. The Meeting estimated a maximum residue level for dimethoate of 0.1 mg/kg and STMRs of 0.1 mg/kg each for dimethoate and omethoate in garden turnips.

The residues of dimethoate on the turnip tops (greens) were <0.1 (5), 0.25 and 0.55 mg/kg and those of omethoate were <0.1 (6) and 0.20 mg/kg. The Meeting estimated a maximum residue level of 1 mg/kg for dimethoate and STMRs of 0.1 mg/kg each for dimethoate and omethoate in turnips greens.

Sugar beet roots and tops. Two trials in the UK complied with UK GAP (2 x 0.40 kg ai/ha, before June 30) and one each in Denmark and The Netherlands with Dutch GAP (3 x 0.40 kg ai/ha, no PHI). Most of the six trials in Germany (GAP 0.16 kg ai/ha, 35-day PHI) were at about twice the GAP rate, but could be included in the evaluation because the residues were at the limit of quantification at the appropriate PHI. The residues of dimethoate in the roots were <0.01 (7), <0.02 (2) and <0.05 mg/kg, and those of omethoate were <0.01 (7), <0.02 and <0.05 mg/kg. The Meeting estimated a maximum residue level for dimethoate of 0.05 mg/kg and STMRs for dimethoate and omethoate of 0.01 mg/kg each in sugar beet (roots).

The residues of dimethoate on the tops were <0.01 (2), <0.02, <0.05, 0.06 and 0.10 mg/kg and those of omethoate <0.01 (2), <0.02, <0.05, 0.05 (2), and 0.17 mg/kg. The Meeting estimated a maximum residue level for dimethoate of 0.1 mg/kg and STMRs for dimethoate and omethoate of 0.05 mg/kg each for sugar beet leaves or tops.

Carrots. Only two of 14 trials in Germany complied with GAP (2 x 0.24 kg ai/ha, 14-day PHI). The Meeting recommended withdrawal of the existing CXL.

Radishes. Twenty trials were carried out in Germany, but no GAP was reported for Germany or any other country. The Meeting could not estimate a maximum residue level or STMR.

Asparagus. In four supervised field trials in the USA which were according to GAP (5 x 0.56 kg ai/ha, 180-day PHI) the residues of dimethoate were <0.02 (3) and <0.03 mg/kg, and those of omethoate

were <0.02 (3) and <0.12 mg/kg. In three additional trials at twice the GAP rate the residues of dimethoate and omethoate were all below the LOD (<0.02 mg/kg). The Meeting estimated a maximum residue level for dimethoate of 0.05* mg/kg and STMRs for dimethoate and omethoate of 0.02 mg/kg each.

Barley grain and straw. Supervised field trials according to GAP were reported from Denmark (GAP 0.80 kg ai/ha; 1 trial), The Netherlands (GAP 0.20 kg ai/ha, 14-day PHI; 2 trials), Germany (2 trials according to Dutch GAP) and the UK (GAP 4 x 0.34 kg ai/ha, 14-day PHI; 3 trials). The residues of dimethoate in the grain were 0.03, 0.06, 0.07, 0.10, 0.41, 0.49, 0.73 and 1.43 mg/kg and those of omethoate <0.01 (2), 0.01 (2), 0.02, 0.03, 0.06 and 0.10 mg/kg. The Meeting estimated a maximum residue level for dimethoate of 2 mg/kg and STMRs of 0.255 mg/kg for dimethoate and 0.015 mg/kg for omethoate in barley grain.

The residues of dimethoate on the straw were 0.09, 0.13, 0.20, 0.44, 0.55, 0.88, 1.59 and 2.81 mg/kg and those of omethoate <0.01, 0.01, 0.03 (3), 0.07 (2) and 0.11 mg/kg. The Meeting estimated STMRs for straw of 0.495 mg/kg for dimethoate and of 0.03 mg/kg for omethoate.

Maize. Two supervised field trials were reported from Denmark, but the PHIs were at least twice the GAP interval. The Meeting could not estimate a maximum residue level or STMR.

Sorghum (grain, forage and hay). Six trials in the USA complied with GAP (3 x 0.56 kg ai/ha, 28-day PHI). All the residues of dimethoate and omethoate in the 5 samples of grain analysed were <0.01 mg/kg. The Meeting estimated a maximum residue level for dimethoate of 0.01* mg/kg and STMRs of 0.01 mg/kg each for dimethoate and omethoate in sorghum grain.

The residues of dimethoate on the forage were <0.01 (4), 0.01 and 0.02 mg/kg and those of omethoate all <0.01 mg/kg. The residues of dimethoate on the hay were <0.01 (5) and 0.01 mg/kg and of omethoate all <0.01 mg/kg. The Meeting estimated STMRs for forage and hay of 0.01 mg/kg each for dimethoate and omethoate.

Wheat grain and straw. One trial each in The Netherlands, Denmark, the UK and Germany complied with UK GAP (4 x 0.68 kg ai/ha low volume, 4 x 0.34 kg ai/ha high volume, 14-day PHI) and three trials in Germany complied with German GAP (2 x 0.24 kg ai/ha, 21-day PHI). The residues of dimethoate in the grain were <0.01, <0.02 , <0.05, 0.09, 0.10, 0.11 and 0.12 mg/kg, and those of omethoate were <0.01 (3), 0.01, 0.02 and <0.05 mg/kg. The Meeting estimated a maximum residue level for dimethoate of 0.2 mg/kg and STMRs of 0.09 mg/kg for dimethoate and 0.01 mg/kg for omethoate in wheat grain.

The residues of dimethoate in or on the straw were <0.02, <0.05, 0.12, 2.23, 2.37, 4.42 and 8.95 mg/kg, and of omethoate <0.02, 0.02, <0.05, 0.08, 0.12, 0.13 and 0.17 mg/kg. The Meeting estimated a maximum residue level of 10 mg/kg for dimethoate and STMRs of 2.23 mg/kg for dimethoate and 0.08 mg/kg for omethoate in wheat straw and fodder, dry.

Chives. Five supervised field trials were carried out in Germany, but no GAP was reported for any country. No maximum residue level or STMR could be estimated.

Witloof chicory. Five trials in The Netherlands did not comply with GAP (5.0 kg ai/ha, 21-day PHI) because the PHIs all exceeded 35 days. The Meeting recommended withdrawal of the existing CXL for witloof chicory (sprouts).

Feeding studies

No feeding studies were reported but the studies of metabolism in hens and goats indicated that dimethoate and omethoate are extensively metabolized. Dimethoate was undetectable in all the

samples and omethoate was found only in hen and goat livers and egg whites after protease treatment of the residue from the solvent extractions.

Possible ruminant feed items include apple pomace, barley grain and straw, wheat grain and straw, potato culls, processed potato waste, sorghum grain, forage and hay, sugar beet tops, molasses and pulp, and turnip roots and tops. Poultry feed may include barley grain and sorghum grain. There was no information available on residues in apple pomace, potato waste and culls or sugar beet molasses and pulp and potential residues in these commodities could not be estimated.

The maximum residues found in supervised field trials with feed items, e.g. wheat straw at 2 mg/kg dimethoate and 0.2 mg/kg omethoate and barley grain at 2 mg/kg dimethoate and 0.1 mg/kg omethoate, indicate that a dairy cow would receive about 7 ppm dimethoate and 0.2 ppm omethoate in the diet and poultry about 1.7 ppm dimethoate and 0.2 ppm omethoate. The metabolism studies were at levels equivalent to 10 ppm dimethoate in the diet for poultry and 30 ppm for goats, or about 5 and 15 times the highest estimated dietary burdens. In the metabolism studies, omethoate was found in liver (0.12 mg/kg in goats, 0.082 mg/kg in hens) and egg whites (0.004 mg/kg). From the calculated dietary burdens, the maximum omethoate residues are estimated to be 0.008 mg/kg in ruminant liver, 0.016 mg/kg in poultry liver, and 0.0008 mg/kg in egg whites.

The Meeting estimated maximum residue levels for ruminant and poultry commodities at the limit of determination, 0.05* mg/kg, for dimethoate. The residues are likely to be much less than 0.05 mg/kg, but the Meeting considered 0.05 mg/kg to be the practical limit of quantification that can be routinely achieved in the laboratory. The Meeting also estimated STMRs of 0 mg/kg each for dimethoate and omethoate in the same commodities.

Processing studies

Processing studies were reported on oranges, tomatoes, potatoes, cotton seed, maize and wheat. The raw wheat and cotton seed contained no quantifiable residues and processing factors could not be determined for these crops. The processing factors and estimated STMRs for the other processed commodities were as follows.

Processed Commodity	Processing factor		Raw agricultural commodity STMR, mg/kg		Processed commodity STMR, mg/kg	
	Dimethoate	Omethoate	Dimethoate	Omethoate	Dimethoate	Omethoate
Orange juice	0.14	0.21	Not available	Not available		
Orange oil	0.19	0.07	Not available	Not available		
Tomato juice	0.11	0.17	0.21	0.05	0.03	0.009
Tomato purée	1.7	1	0.21	0.05	0.4	0.05
Tomato paste	2.9	1.4	0.21	0.05	0.6	0.07
Tomato ketchup	1.8	1	0.21	0.05	0.4	0.05
Potato granules (flakes)	0.12	-	0.01	0.01	0.002	0.002
Potato chips	0.12	-	0.01	0.01	0.002	0.002
Refined cotton seed oil	0.34	-	Not available	Not available		
Maize meal	0.34	-	Not available	Not available		
Maize grits	0.34	-	Not available	Not available		
Maize flour	0.34	-	Not available	Not available		
Maize starch	0.17	-	Not available	Not available		
Refined maize oil	0.17	-	Not available	Not available		

RECOMMENDATIONS

On the basis of data from supervised trials the Meeting estimated the maximum residue levels for dimethoate listed below (first table).

No data were submitted to support the existing MRLs for omethoate and the Meeting accordingly recommended their withdrawal (second table).

The Meeting concluded that the combined intakes of dimethoate and omethoate, adjusted as explained below (Dietary Risk Assessment), might exceed the ADI for dimethoate. The maximum residue levels estimated for dimethoate are therefore recommended for use as MRLMs, not MRLs.

Definition of the residue for compliance with MRLs: dimethoate.

Definition of the residue for the estimation dietary intake: sum of dimethoate and omethoate, each considered separately.

Dimethoate

Commodity		Recommended MRLM, mg/kg		STMR, mg/kg
CCN	Name	New	Previous	
FP 0226	Apple	W[1]	1	
VS 0621	Asparagus	0.05*	-	0.02
FI 0327	Banana	W	1 Po	
GC 0640	Barley	2	-	0.255
AS 0640	Barley straw and fodder, dry	-	-	0.495
VR 0574	Beetroot	W	0.2	
VB 0402	Brussels sprouts	1	2	0.065
VB 0041	Cabbages, Head[2]	2	2	0.46
VB 0403	Cabbage, Savoy	0.05*	-	0.02
VR 0577	Carrot	W	1	
MO 0812	Cattle, Edible offal of	0.05*	-	0
VB 0404	Cauliflower	0.5	-	0.065
VS 0624	Celery	W	1	
FS 0013	Cherries	2	2	0.06
FC 0001	Citrus fruits	W	2	
FB 0278	Currant, Black	W	2	
PE 0112	Eggs	0.05*	-	0
FB 0269	Grapes	2	1	0.48
DH 1100	Hops, dry	W	3	
VL 0480	Kale	W	0.5	
VL 0482	Lettuce, Head	0.5	2	0.02
MF 0100	Mammalian fats (except milk fats)	0.05*	-	0
MM 0096	Meat of cattle, goats, horses, pigs and sheep	0.05*	-	0
ML 0107	Milk of cattle, goats and sheep	0.05*	-	0
OR 0305	Olive oil, refined	W	0.05*	
FT 0305	Olives	W	1	
DM 0305	Olives, processed	W	0.05*	
VA 0385	Onion, Bulb	0.05*	0.2	0.02
FS 0247	Peach	W	2	
FP 0230	Pear	W[1]	1	
VP 0063	Peas (pods and succulent = immature seeds)	1	0.5	0.065
VO 0051	Peppers	W	1 Po	
FS 0014	Plums (including Prunes)	1	0.5	0.1
FP 0009	Pome fruits	0.5	-	0.065
VR 0589	Potato	0.05	0.05	0.01

Commodity		Recommended MRLM, mg/kg		STMR, mg/kg
CCN	Name	New	Previous	
	Potato granules			0.002
	Potato chips			0.002
PO 0111	Poultry, Edible offal of	0.05*	-	0
PF 0111	Poultry fats	0.05*	-	0
PM 0110	Poultry meat	0.05*	-	0
MO 0822	Sheep, Edible offal of	0.05*	-	0
GC 0651	Sorghum	0.01*	-	0.01
AF 0651	Sorghum forage (green)	-	-	0.01
AS 0651	Sorghum straw and fodder, dry	-	-	0.01
VL 0502	Spinach	W	1	
FB 0275	Strawberry	W	1	
VR 0596	Sugar beet	0.05	0.05	0.01
AV 0596	Sugar beet leaves or tops	0.1	1 T	0.05
VO 0448	Tomato	2	1 Po	0.21
JF 0448	Tomato juice			0.03
	Tomato purée			0.4
	Tomato paste			0.6
	Tomato ketchup			0.4
VR 0506	Turnip, Garden	0.1	0.5	0.1
VL 0506	Turnip greens	1	-	0.1
GC 0654	Wheat	0.2	-	0.09
AS 0654	Wheat straw and fodder, dry	10	-	2.23
VS 0469	Witloof chicory (sprouts)	W	0.5	

[1]Replaced by recommendation for Pome fruits
[2]Except Savoy cabbage

Omethoate

Commodity		Recommended MRLM (mg/kg)		STMR (mg/kg)
CCN	Name	New	Previous	
FP 0226	Apple	W	2	
FS 0240	Apricot	W	2	
VS 0620	Artichoke, Globe	W	0.5	
VS 0621	Asparagus	-	-	0.02
FI 0327	Banana	W	0.2*	
GC 0640	Barley	-	-	0.015
AS 0640	Barley straw and fodder, dry	-	-	0.03
VP 0061	Beans, except broad bean and soya bean	W	0.2	
VB 0400	Broccoli	W	0.2	
VB 0402	Brussels sprouts	W	0.2	0.03
VB 0403	Cabbage, Savoy	-	-	0.075
VB 0041	Cabbages, Head	W	0.5 T	0.165
VR 0577	Carrot	W	0.05	
VB 0404	Cauliflower	W	0.2	0.01
VS 0624	Celery	W	0.1	
GC 0080	Cereal grains	W	0.05	
FS 0013	Cherries	W	2	0.27
FC 0001	Citrus fruits	W	2	
VC 0424	Cucumber	W	0.2	
FB 0278	Currant, Black	W	2	
FB 0269	Grapes	W	2	0.11
DH 1100	Hops, dry	W	3	
VL 0480	Kale	W	0.2	
VL 0482	Lettuce, Head	W	0.2	0.03
VL 0483	Lettuce, Leaf	W	0.2	
VA 0385	Onion, Bulb	W	0.5	0.02

Commodity		Recommended MRLM (mg/kg)		STMR (mg/kg)
FS 0247	Peach	W	2	
FP 0230	Pear	W	2	
VP 0063	Peas (pods and succulent = immature seeds)	W	0.1	0.02
VO 0051	Peppers	W	1	
FS 0014	Plums (including Prunes)	W	1	0.05
FP 0009	Pome fruits	-	-	0.05
VR 0589	Potato	W	0.05	0.01
	Potato chips			0.002
	Potato granules			0.002
GC 0651	Sorghum	-	-	0.01
AF 0651	Sorghum forage (green)	-	-	0.01
AS 0651	Sorghum straw and fodder, dry	-	-	0.01
VL 0502	Spinach	W	0.1	
FB 0275	Strawberry	W	1	
VR 0596	Sugar beet	W	0.05	0.01
AV 0596	Sugar beet leaves or tops	W	1T	0.05
VO 0448	Tomato	W	0.5	0.05
JF 0448	Tomato juice	-	-	0.009
	Tomato purée			0.05
	Tomato paste			0.07
	Tomato ketchup			0.05
VR 0506	Turnip, Garden	W	0.2	0.1
VL 0506	Turnip greens	-	-	0.1
GC 0654	Wheat	-	-	0.01
AS 0654	Wheat straw and fodder, dry	-	-	0.08
VS 0469	Witloof chicory (sprouts)	W	0.5	

FURTHER WORK OR INFORMATION

Desirable

A plant metabolism study that provides detailed results and includes data on translocation is highly desirable. A root crop is suggested.

DIETARY RISK ASSESSMENT

The Meeting considered approaches to the dietary risk assessment of mixed residues of dimethoate and omethoate, resulting from the use of dimethoate. Noting that the ADI for omethoate had been withdrawn by the JMPR (Evaluations 1996, Part II – Toxicological), the Meeting considered that it would be inappropriate to rely on the previous omethoate ADI in the dietary risk assessment. However, the Meeting noted that the toxicity of omethoate was generally about ten times that of dimethoate across a range of toxic endpoints dependent upon cholinesterase inhibition, reflecting the fact that it is an active metabolite of dimethoate. The Meeting considered that it would be appropriately conservative to multiply the omethoate component of the residue by a tenfold factor, for comparison of the combined residues with the current dimethoate ADI.

STMRs for dimethoate derived from residues of dimethoate in or on commodities have been combined with STMRs for omethoate derived from residues of omethoate arising from the use of dimethoate multiplied by a factor of 10. Dietary intakes estimated from the combined adjusted STMRs were compared with the dimethoate ADI (0.002 mg/kg bw).

The International Estimated Daily Intakes for the GEMS/Food European diet was 140% of the ADI. International Estimated Daily Intakes for the other four GEMS/Food regional diets were in the range of 10 to 80% of the ADI. The Meeting concluded that the combined dietary intakes of dimethoate and omethoate residues, expressed as described above, may exceed the ADI for dimethoate for the European diet. The recommended MRLs are therefore designated as MRLMs.

The Meeting identified wheat, tomatoes and potatoes as the main contributors to the dietary exposure.

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