DELTAMETHRIN (135)

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EXPLANATION

Deltamethrin has been evaluated several times since the initial evaluation in 1980. It was last evaluated in 1992 for residues and in 2000 for toxicology. At the 30th Session of the CCPR, the Committee noted that deltamethrin was on the agenda of the 52nd JECFA (1999). At the 31st Session of the CCPR, the committee noted the MRLs estimated by JECFA for veterinary uses would be circulated for comments at step 3, through CL-RVDF, governments were invited to co-ordinate their comments at the national level. Deltamethrin was identified as a priority compound under the Periodic Re-evaluation Program at the 29th Session of the CCPR and scheduled for the 2002 JMPR.

Data to support the existing CXLs and other critical data required for the estimation of MRLs have been provided by the company.

The governments of Australia, The Netherlands, Poland and Germany have submitted information on national GAP and/or residue data.

IDENTITY

ISO Common name: deltamethrin

Chemical name:

IUPAC: (*S*)-α-cyano-3-phenoxybenzyl (1*R*,3*R*)-3-(2,2-dibromovinyl)-2,2-dimethylcyclopropanecarboxylate

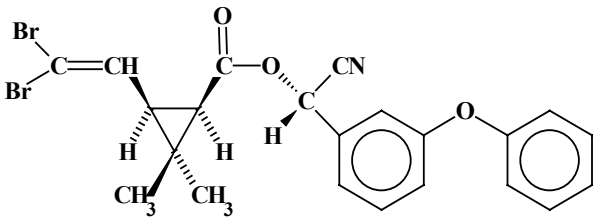
CA: [1*R*-[1α(*S**),3α]]-cyano(3-phenoxyphenyl)methyl 3-(2,2-dibromoethenyl)-2,2-dimethylcyclopropanecarboxylate

CAS No.: [52918-63-5]

CIPAC No.: 333

Synonyms/trade names: decamethrin, AE F032640, RU 22974, HOE 032640, NRDC 161, FMC 45498

Structural formula:



Molecular formula: $C_{22}H_{19}Br_2NO_3$

Molecular weight: 505.2

Physical and chemical properties

Pure active ingredient

Appearance: off-white solid powder (technical grade) (Thomas and Sweetapple, 1990)

Melting point: 100-102°C (373-375°K), (technical grade) (Sweetapple, 1990)

Partition coefficient, log P_{ow}: 4.6 at 25 °C, pH 7,6 (not pH dependent) (Yoder, 1991a)

Hydrolysis:

pH 5 (buffered): negligible (Smith, 1990a)
pH 7 (buffered): negligible (Smith, 1990a)
pH 9 (buffered): half-life 2.5 days (mean value) (Smith, 1990a)
pH 8 (buffered): half-life 31 days (Maurer and Schäfer, 2002)

Photolysis: half-life 48 days. Quantum yield in wavelength range 290-385 nm was calculated to be 8.72×10^{-4} (C008524)

Dissociation constant: deltamethrin is neither acid nor alkaline and dissociation is not expected to occur at environmentally relevant pH

Technical material

Minimum purity: 980 g/kg (technical grade)

Vapour pressure:

1.24×10^{-8} Pa at 25ºC
4.13×10^{-8} Pa at 35ºC
1.98×10^{-7} Pa at 45ºC (Yoder, 1991b)

Volatility: Henry's law constant: 3.1×10^{-2} Pa·m^3/mol based on a water solubility of 0.2 µg as/l and a vapour pressure of 1.24×10^{-8}, both at 25ºC (A70747) (Grelet, 1995)

Appearance: off-white solid powder (technical grade)

Odour: odourless

Density: 0.550 g/cm^3

Table 1. Solubility of deltamethrin.

Solvent	Solubility
Water:	0.2 µg/l at 25ºC (A26313, C009221) (Jamet and Hascoet, 1977; Mühlberger and Jordan, 2000a)
Organic Solvents:	Results measured at 20° C (A45109, C009220) (Yoder 1990, Mühlberger and Jordan 2000b)
Cyclohexane	1-10%
benzene and toluene	10-50%
Xylenes	18 g/100ml at 25ºC
1,1,1-trichloroethane	10-50%
iso-propanol	<1%
Ethanol	1-10%
n-octanol	0.526 g/100ml at 25ºC
Glycerol	<1%
Acetone	10-50%

Solvent	Solubility
Cyclohexanone	>50%
ethyl acetate	10-50%

Thermal stability: stable to 270°C (Sanders, 1991)

Flammability: not flammable or auto-flammable (Hoffmann, 1996a,b)

Oxidizing potential: not oxidizing (Smeykal, 2000)

Explosivity: not explosive (Smeykal, 2000)

Formulations

The following Table includes the major formulations developed for deltamethrin crop and animal health uses around the world.

Table 2. Deltamethrin formulations and codes.

Type	Code number	Concentration
Agriculture		
Emulsifiable concentrate (EC)	AE F032640 00 EC03 BO	25 g/l
Emulsifiable concentrate (EC)	AE F032640 00 EC11 A3	100 g/l
Emulsifiable concentrate (EC)	AEF 032640 00 EC02 A8	15 g/l
Emulsion, oil in water (EW)	AE F032640 00 EW01 B1	15 g/l
Suspension concentrate (SC)	AE F032640 00 SC02	50 g/l or 25 g/l
Ultra low volume (UL)	AE F032640 00 UV01	5 g/l
Emulsifiable granule (EG)	AE F032640 00 EG06 A1	60 g/kg
Tablet (TB)	AE F032640 00 TB25 A1	250 g/kg
Animal health		
Dip, spray	AE F032640 00 WP05 A2	50 g/l
Pour-on		7.5 g/l

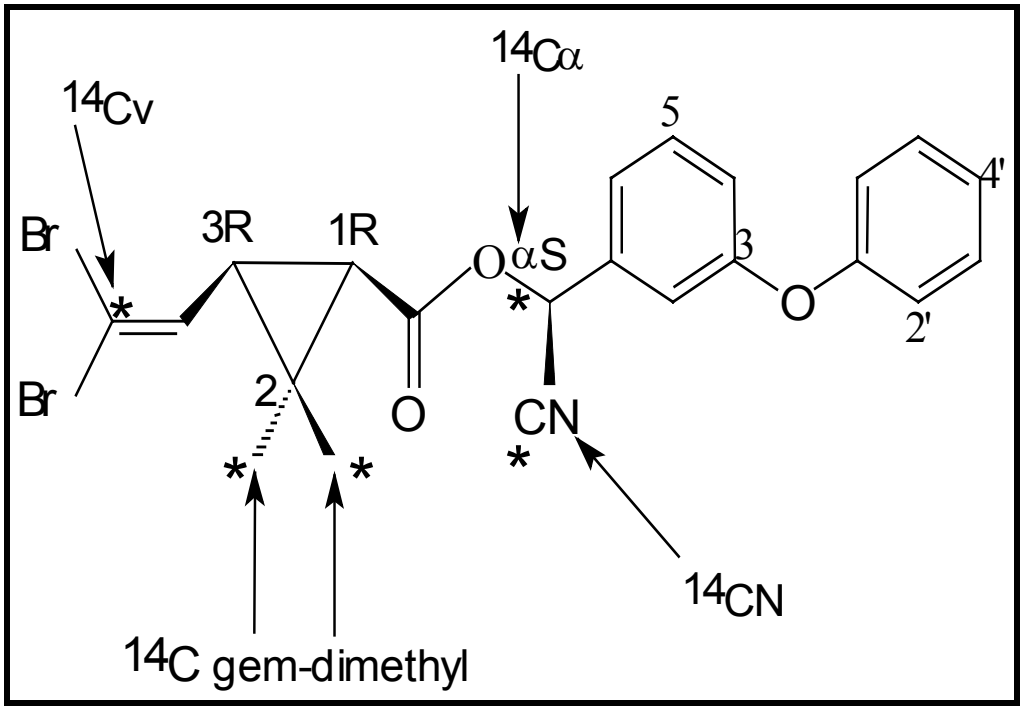
METABOLISM AND ENVIRONMENTAL FATE

Animal metabolism

Metabolism studies on rats, goats and hens with [^{14}C]deltamethrin and [^{13,14}C]deltamethrin were made available to the Meeting. The metabolism of laboratory animals was reported by the 2000 JMPR as part of a review of the toxicology of deltamethrin and is qualitatively the same as for farm animals.

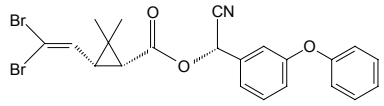
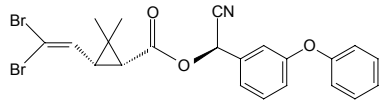
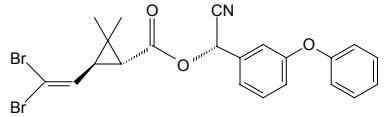
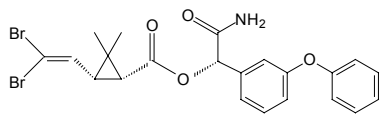
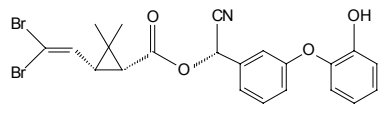
To carry out various metabolism, degradation and toxicological or ecotoxicological studies, the deltamethrin molecule has been labelled on various carbon atoms:

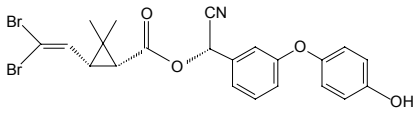
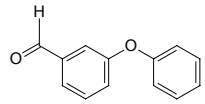
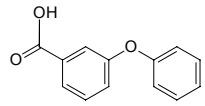
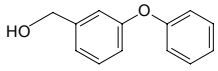
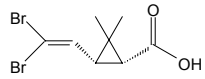
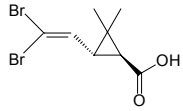
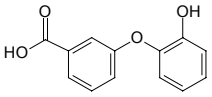
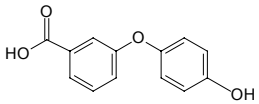
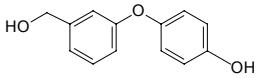
[^{14}C-dibromovinyl]deltamethrin labelled on Cv
[^{14}C-benzyl]deltamethrin labelled on Cα
[^{14}C-cyano]deltamethrin labelled on CN
[^{14}C-*gem*-dimethyl]deltamethrin labelled on $(CH_3)_2$



The following Table shows the main degradation products of deltamethrin and the abbreviations used for some metabolites.

Table 3. Relationship between abbreviated, common and chemical names, company codes and structural formulae.

Common name or abbreviation	Roussel Uclaf code	Chemical name (generally CAS)	Structural formula
deltamethrin	RU 22974	(*S*)-α-cyano-3-phenoxybenzyl (1*R*,3*R*)-3-(2,2-dibromovinyl)-2,2-dimethylcyclopropanecarboxylate	
α-*R*-deltamethrin	RU 23938	*(R)*-α-cyano-3-phenoxybenzyl (1*R*,3*R*)-3-(2,2-dibromovinyl)-2,2-dimethylcyclopropanecarboxylate	
trans-deltamethrin	RU 26979	[1*R*-[1α(*S**),3β]]-3-(2,2-dibromoethenyl)-2,2-dimethyl-cyclopropanecarboxylic acid, cyano(3-phenoxyphenyl)methyl ester	
deltamethrin amide	RU 38250	[1*R*-[1α(*S**),3 α]]-3-(2,2-dibromoethenyl)-2,2-dimethyl-cyclopropanecarboxylic acid, 2-amino-2oxo-1-(3-(phenoxyphenyl)ethyl ester	
2-OH-deltamethrin	RU 51713	[1*R*-[1α(*S**),3α]]-3-(2,2-dibromoethenyl)-2,2-dimethyl-cyclopropanecarboxylic acid, cyano(3-(2-hydroxyphenoxyphenyl)methyl ester	

Common name or abbreviation	Roussel Uclaf code	Chemical name (generally CAS)	Structural formula
4-OH-deltamethrin	RU 53605	[1*R*-[1α(*S**),3α]]-3-(2,2-dibromoethenyl)-2,2-dimethyl-cyclopropanecarboxylic acid, cyano(3-(4-hydroxyphenoxyphenyl)methyl ester	
*m*PB aldehyde	RU 26684	3-phenoxybenzaldehyde	
*m*PB acid	RU 50293	3-phenoxybenzoic acid	
*m*PB alcohol	RU 27330	3-phenoxybenzenemethanol	
(*cis*) Br_2CA	RU 23441	(1*R*-*cis*)-3-(2,2-dibromoethenyl)-2,2-dimethylcyclopropanecarboxylic acid	
(*trans*) Br_2CA	RU 28302	(1*R*-*trans*)-3-(2,2-dibromoethenyl)-2,2-dimethylcyclopropanecarboxylic acid	
2'OH *m*PB acid	RU 50961	3-(2-hydroxyphenoxy)benzoic acid	
4'OH *m*PB acid	RU 46606	3-(4-hydroxyphenoxy)benzoic acid	
4'OH *m*PB alcohol	RU 46605	3-(4-hydroxyphenoxy)benzenemethanol	

Deltamethrin is the [1*R*,*cis*; α-*S*]-isomer of 8 stereoisomeric esters derived from esterification of the dibromo analogue of chrysanthemic acid, 3-(2,2-dibromovinyl)-2,2-dimethylcyclopropanecarboxylic acid (Br_2CA) with α-cyano-3-phenoxybenzyl alcohol.

Lactating cows. Akhtar *et al.* (1986) dosed a lactating dairy Holstein 557 kg bw and an Ayrshire 504 kg bw cow with [^{14}C]deltamethrin (*gem*-dimethyl or benzyl) at 10 mg/kg bw/day for 3 consecutive days. Urine and faeces were collected for each 24-hour period and milk twice daily. The animals were slaughtered 24 hours after the last dose. Radioactivity in all samples was quantified and characterized by TLC and GC.

Deltamethrin appeared to be poorly absorbed and mainly eliminated in the faeces (cumulative total 36-43% of the administered dose) within 24 hours of the last dose as deltamethrin(s); 78-82% of

the ^{14}C in faeces. The cumulative total for elimination in the urine until 24 hours after the last dose was only 4-6 % of the administered ^{14}C, and 0.42-1.6 % was secreted in the milk.

Total deltamethrins were also the major identifiable products in milk (0.10-0.14 mg/kg). The radiocarbon content in various tissues was generally very low (<0.1 mg/kg deltamethrin equivalents) with the exception of liver, kidney, udder, and abdominal and subcutaneous fats.

Table 4. Distribution of ^{14}C in the tissues of lactating cows dosed orally with [^{14}C]deltamethrin at 10 mg/kg bw for three consecutive days (Akhtar *et al.,* 1986).

Sample	[^{14}C]deltamethrin equivalents (mg/kg)	
	gem-dimethyl	benzyl
Liver	2.2	3.2
Kidney	1.3	2.2
Brain	-	0.09
Heart	0.12	0.13
Breast muscle	-	0.06
Leg muscle	-	0.09
Spleen	-	0.08
Udder	0.42	0.62
Lung	-	0.21
Abdominal fat	0.28	0.56
Subcutaneous fat	0.40	0.54
Tongue	-	0.16
Bile	6.4	21

Table 5. Characterization of ^{14}C in liver, kidney and abdominal fat of lactating cows dosed orally with ^{14}C-*gem*-dimethyl- or ^{14}C-benzyl-labelled deltamethrin for three consecutive days (% of the TRR) (Akhtar *et al.,* 1986).

Compound	Liver		Kidney		Fat	
	gem	benzyl	*gem*	benzyl	*gem*	benzyl
Deltamethrin[1]	24	23	32	35	60	90
Br_2CA	23		33		16	
*m*PB aldehyde		trace		trace		trace
*m*PB acid		32		23		
Water-soluble	16	10	16	18		
Unextractable	37	23	19	24		

[1] method did not resolve deltamethrin from its isomers, the numbers therefore refer to "total deltamethrin isomers"

Degradation of deltamethrin was by cleavage of the ester bond. The resulting metabolites were further metabolized and/or conjugated, resulting in a large number of products being excreted in the urine.

Hens. Leghorn laying hens were orally dosed with 7.5 mg of *gem*-dimethyl- or benzyl-labelled deltamethrin/hen/day for 3 consecutive days (Akhtar *et al.,* 1985). The exaggerated dose level is equivalent to a feed level of 50 ppm. Excreta was collected at 24 h intervals and eggs daily. The animals were killed 6, 18, 48 and 120 hours after treatment. Radioactivity levels in excreta, eggs and tissues were quantified and characterized by TLC, GLC and GC-MS.

More than 90% of the administered dose was eliminated within 48 hours of the last dose with both labels.

Table 6. Distribution of ^{14}C residues in eggs of laying hens orally dosed with [^{14}C]deltamethrin at 7.5 mg/bird for three consecutive days (Akhtar *et al.,* 1985).

Days of dosing[1]	TRR (mg/kg deltamethrin equivalents)			
	White		Yolk	
	[^{14}C-*gem*-dimethyl]deltamethrin	[^{14}C-benzyl]deltamethrin	[^{14}C-*gem*-dimethyl]deltamethrin	[^{14}C-benzyl]deltamethrin
1	0.052	<LOD	0.019	0.003
2	0.12	<LOD	0.12	0.069
3 (1)	0.15	0.10	0.40	0.18
4 (2)	0.19	0.007	0.58	0.25
5 (3)	0.026	<LOD	0.49	0.21
6 (4)	0.005	<LOD	0.44	0.22
7 (5)	<LOD	<LOD	0.39	0.20

[1] figures in brackets number of days since last dose

Residues in eggs increased from one day after dosing to reach a peak at 48 h after the last dose. Levels were higher in the yolk (up to 0.6 mg eq/kg) than in the white (up to 0.2 eq mg/kg) and dissipated more quickly from the whites on cessation of dosing. Approximately 32-65% of the ^{14}C in the white and 27-66% from the yolk was extracted with acetonitrile/ether. In yolks more than 70% of the extracted ^{14}C appeared to be present as deltamethrin from a comparison of retention times of spots in the TLC, but this could not be confirmed by GC-MS owing to interfering peaks.

Table 7. Distribution of ^{14}C residues in tissues of laying hens orally dosed with [^{14}C-*gem*-dimethyl]deltamethrin or [^{14}C-benzyl]deltamethrin at 7.5 mg/bird for three consecutive days 6-120 hours after the last dose (Akhtar *et al.,* 1985).

	TRR (mg/kg deltamethrin equivalents)			
	6 h	18 h	48 h	120 h
[^{14}C-*gem*-dimethyl]deltamethrin				
Liver	0.27, 0.49	1.9, 2.4, 4.0, 1.9	0.52, 0.44	0.58, 0.12
Kidney	0.43, 0.79	4.6, 3.8, 6.9, 3.4	0.86, 1.1	0.25, 0.26
Heart	0.02, 0.02	0.61, 0.31, 0.43, 0.21	0.05, 0.07	0.09, 0.04
Subcutaneous fat	0.14	0.47, 0.12, 0.26, 0.39	0.17, 0.12	0.04, 0.19
Abdominal fat	0.15	0.66, 0.27, 0.41, 0.25	0.18, 0.07	0.08, 0.13
Breast muscle	0.03, 0.02	0.14, 0.09, 0.21, 0.08	0.18, 0.09	0.01, <0.005
Leg muscle	0.02, 0.02	0.10, 0.15, 0.14, 0.09	0.09, 0.09	0.01, <0.005
Ovarian yolk	0.31, 0.76	3.3, 1.4, 1.2, 2.1	0.67, 0.69	<0.005, 0.06
Gizzard	0.05, 0.02	0.27, 0.35, 0.61, 0.29	0.06, 0.08	0.04, 0.01
Blood	0.07, 0.11	0.79, 1.0, 1.0, 0.41	0.13, 0.15	0.05, 0.08
[^{14}C-benzyl]deltamethrin				
Liver	0.19, 0.35	0.36, 0.97, 0.89, 0.63	0.19, 0.23	0.06, 0.09
Kidney	0.27, 0.72	1.2, 2.5, 2.1, 1.3	0.25, 0.52	0.11, <0.005
Heart	0.02, 0.09	0.04, 0.09, 0.07, 0.08	0.04, 0.08	<0.005, <0.005
Subcutaneous fat	2.0, 0.09	0.08, 0.17, 0.13, 0.16	0.11, 0.37	0.12, 0.11
Abdominal fat	<0.005, 0.12	0.09, 0.31, 0.11, 0.17	0.13, 0.25	0.13, 0.12
Breast muscle	0.04, 0.02	<0.005 (2), 0.15, 0.08	0.08, 0.03	<0.005, <0.005
Leg muscle	0.12, 0.02	0.01, 0.09, 0.02, 0.05	0.03, 0.03	<0.005, <0.005
Ovarian yolk	0.45, 0.32	0.53, 0.79, 0.54, 0.78	0.16, 0.43	0.02, 0.08
Gizzard	1.2, 0.03	0.08, 0.24, 0.12, 0.23	0.7, 0.07	<0.005, 0.04
Blood	0.12, 0.04	0.17, 0.34, 0.25, 0.18	0.06, 0.14	0.02, 0.02

Approximately 25-57% of the ^{14}C in liver and over 80% in kidneys was extracted with acetonitrile/ether. More than 90% of the extracted ^{14}C from the liver was tentatively assigned to total deltamethrins (isomers not resolved in the system used) by comparison of the retention time with an authentic standard, and total deltamethrins accounted for 31-35% of the residue from the kidneys. Other major compounds tentatively identified were Br_2CA, *cis*- and *trans*-COOH-*cis*-Br_2CA (27-28%), *cis*-CH_2OH-*cis*-Br_2CA and *trans*-COOH-*cis*-CH_2OH-*cis*-Br_2CA lactone (19-27%). A spot accounting for approximately 0-23% of the ^{14}C on the TLC plate was not identified.

The metabolic pathways of deltamethrin in laying hens involve hydrolysis of the ester, followed by hydroxylation of one or both *gem*-dimethyl groups and hydroxylation of the phenoxybenzyl moiety. The major radiolabelled material identified in the liver, kidneys and eggs was unchanged deltamethrin.

A kinetic study in laying hens to follow distribution and excretion of ^{14}C after a single intravenous administration of deltamethrin and to provide information on possible persistence of residues in organs and tissues was carried out by Van Dijk and Burri (1993). [^{14}C-benzyl]deltamethrin was administered at an average dose of 0.4 mg/kg/bw and radioactivity levels measured in excreta and selected organs and tissues after 1, 4, 24 and 120 hours.

About 40% of the dose was excreted within the first 4 hours, 47-60% within 24 and 64% within 120 hours, with average recoveries of ^{14}C of 66%. One hour after administration the concentration of ^{14}C in the blood was 0.4 mg eq/kg and the highest levels were found in the liver (1.1 mg eq/kg) and kidney (1.0 mg eq/kg). Radioactivity was rapidly eliminated from the blood with a half-life of 5.5 hours. The half-lives in the selected samples were relatively low, ranging from 6 to 10 hours, except in fat (>24 hours), ovaries (53 hours) and skin from the back region (17 hours).

The study indicated that intravenously administered deltamethrin showed some persistence in fat. In general deltamethrin was rapidly and efficiently eliminated from most organs, tissues and blood and rapidly excreted, mainly within the first 48 hours.

The metabolism of deltamethrin in rats, lactating cows and laying hens dosed orally shows similar pathways. Deltamethrin is readily metabolized and excreted with half-lives of less than 24 hours. In urine only metabolites were detected, and in faeces the parent compound in addition to identified metabolites.

The basic metabolic reactions involve cleavage of the ester bond by oxidation and/or hydrolysis, followed by oxidation of the released acid and alcohol moieties. The acid moiety (Br_2CA) is transformed into conjugates, chiefly the glucuronide, and excreted in urine. It can also be hydroxylated at one of the *gem*-methyl groups, which is in turn conjugated and excreted. The unstable alcohol moiety is transformed via the aldehyde into the acid (*m*PB acid), which undergoes further oxidation by hydroxylation on aromatic rings and then is extensively excreted in urine, mainly as the 4'OH sulfate conjugate.

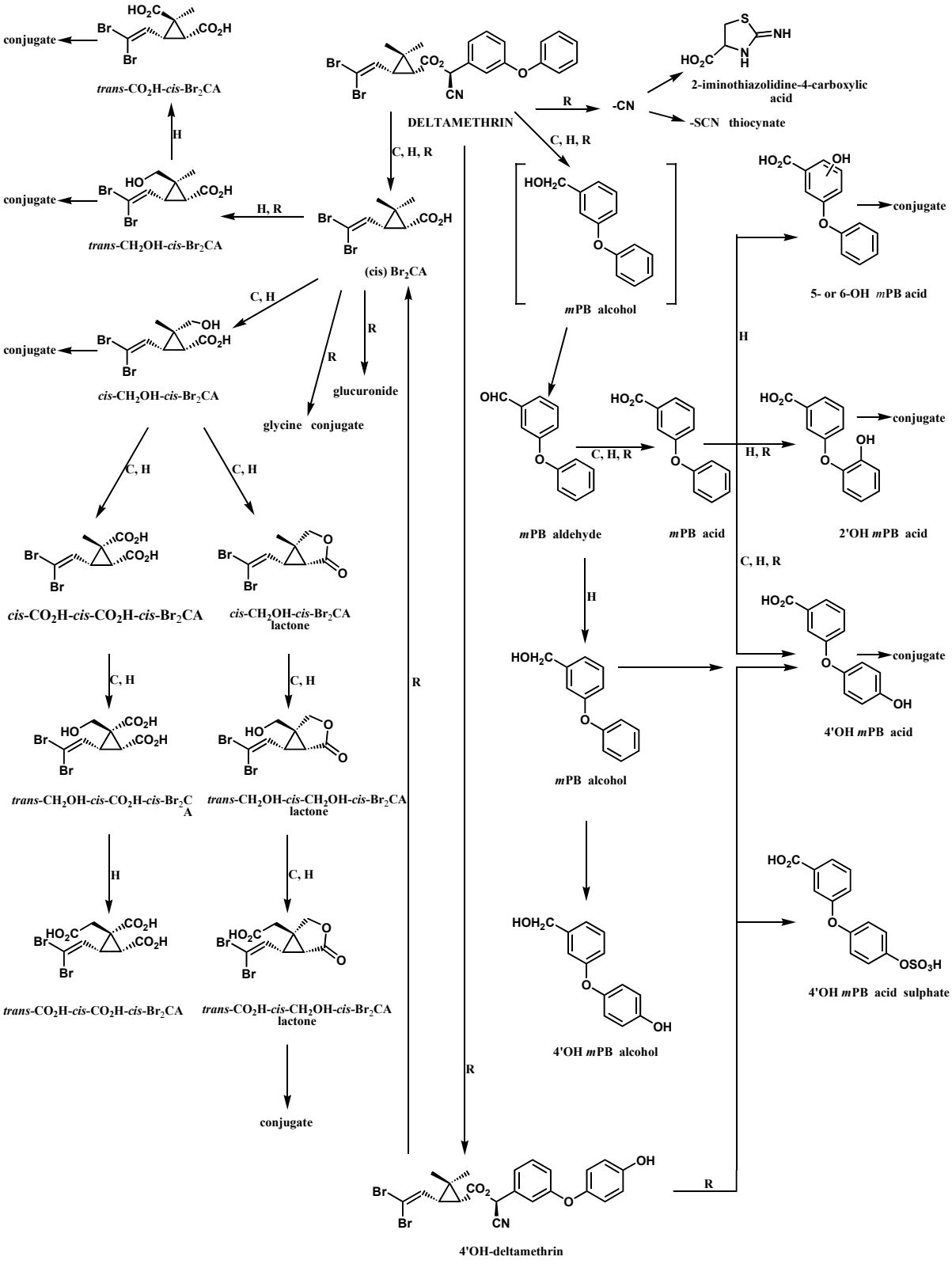


Figure 1. Proposed metabolic pathways of deltamethrin in animals (R = rat, H = hen, C = cow).

Plant metabolism

Studies on cotton, maize, apple and tomato were reported to the Meeting.

Cotton. Root uptake and translocation of [^{14}C]deltamethrin has been investigated in plants grown in a climatic chamber (Salmon and Van Assche, 1977). The test material was applied separately as a foliar, soil and hydroponic treatment to seedlings, at the appearance of the first fully developed leaf, grown in plastic pots (2-5 plants per pot) in glass chambers. Air was flushed through the chambers and any released $^{14}CO_2$ collected in traps. Plants were harvested 1, 3 and 7 days after treatment for autoradiography and extraction with methanol followed by partitioning of the extract with hexane and water for analysis by TLC with LSC.

Hydroponic treatment at 6.7 mg/plant resulted in significant root uptake. Autoradiography indicated very limited translocation of deltamethrin or its metabolites from the roots into the foliage.

Table 8. Distribution of radioactivity (mg/kg deltamethrin equivalents) in extracts of cotton shoots and roots of plants after hydroponic treatment at 6.5 mg [^{14}C]deltamethrin per plant (Salmon and Van Assche, 1977).

	Shoot			Roots		
Days after treatment	1	3	7	1	3	7
Polar (methanol/water)	0.028	0.17	0.35	0.042	1.34	1.84
Non-polar (hexane)	0.4	0.14	0.17	1.13	1.57	1.49
Unextracted residues (solids)	0.07	0.033	0.26	0.6	0.5	4.64

The foliar treatment at 0.0089 mg/plant also indicated a very limited translocation of deltamethrin throughout the plant and that it has no systemic behaviour (no downwards transport through the phloem). Autoradiography showed a distribution of the radioactivity along the veins where the test material was applied.

Table 9. Distribution of radioactivity (mg/kg deltamethrin equivalents) in extracts of leaves and roots of cotton plants after foliar treatment at 0.0089 mg [^{14}C]deltamethrin per plant (Salmon and Van Assche, 1977).

	Treated leaf			Untreated part			Roots		
Days after treatment	1	3	7	1	3	7	1	3	7
Polar (methanol/water)	4.6	4.1	3.7	0.05	0.16	0.05	0.007	0.02	0.02
Non-polar (hexane)	83	77	78	0.23	0.07	0.17	0.02	0.06	0.12
Unextracted residues (solids)	1.5	3.6	9.2	0.01	0.01	0.02	0.002	0.006	0.04

After soil treatments at 0.18 mg/plant deltamethrin was substantially absorbed by the roots but translocation remained very limited. Most of the radioactivity in the shoots was concentrated in the polar and unextracted residue fractions.

Table 10. Distribution of radioactivity (mg/kg deltamethrin equivalents) in extracts of shoots and roots of cotton plants after soil treatment at 6.5 mg [^{14}C]deltamethrin per plant (Salmon and Van Assche, 1977).

	Shoot			Roots		
Days after treatment	1	3	7	1	3	7
Polar (methanol/water)	0.07	0.12	0.44	0.015	0.04	0.01
Non-polar (hexane)	0.03	0.036	0.058	0.075	0.11	0.2
Unextracted residues (solids)	0.1	0.29	1.13	0.011	0.042	0.15

The metabolism of [^{14}C]deltamethrin in Stoneville 7A cotton plants was studied under glasshouse and field conditions during 1977 in the USA using material labelled at the dibromovinyl, benzyl, and cyano carbons (Ruzo and Casida 1979). The plant foliage was treated with [^{14}C]deltamethrin at 0.04-0.33 μg/cm^2 (3-15 mg/kg based on fresh leaf weight), and leaf samples 2 and 6 weeks after treatment were extracted with acetonitrile/chloroform (2:1) with individual

components of the ^{14}C extracts separated by TLC. Radiocarbon in the unextractable residue was determined by combustion.

Under glasshouse conditions the initial half-life of deltamethrin was 1.1 weeks. Conversion of deltamethrin to *trans*-deltamethrin occurred by photochemical reactions so that after 6 weeks the *trans*:*cis* ratio was 0.4:1.

Deltamethrin was degraded more rapidly under field conditions to give a higher proportion of *trans*-deltamethrin to deltamethrin at 2 weeks and large amounts of unextracted products. Trace amounts of three deltamethrin derivatives, hydroxylated either at the 4'-position (4'OH-deltamethrin), or at the methyl *trans* to the carboxy group in the acid moiety or at both sites, were detected with all three ^{14}C preparations. However the major metabolites were free and conjugated Br_2CA together with small quantities of the *trans*-hydroxymethyl derivatives of Br_2CA and 4'OH *m*PB acid. Several types of conjugated metabolites were isolated but not fully characterized. One type was cleaved readily with β-glucosidase or HCl to yield Br_2CA and *m*PB acid; two others were resistant to β-glucosidase but cleaved readily with hydrogen chloride to yield Br_2CA (dibromovinyl label), *m*PB acid and alcohol (benzyl label) and α-cyano-3-phenoxybenzyl alcohol (cyano and alcohol labels).

Table 11. Characterization of ^{14}C in the leaves of glasshouse and field-grown cotton plants treated with [^{14}C]deltamethrin (Ruzo and Casida, 1979).

Compound	^{14}C after treatment, % of applied dose			
	Greenhouse		Field	
	2 weeks	6 weeks	2 weeks	6 weeks
Esters (average results for ^{14}C-dibromovinyl-, ^{14}C-benzyl- and ^{14}C-cyano labels)				
deltamethrin	27	6.1	11	1.7
trans-deltamethrin	5.1	2.7	7.8	0.7
4'-OH-deltamethrin	0.2	0.3	0.6	0.1
trans-OH-deltamethrin	0.5	0.3	0.8	0.1
4'-OH,*t*-OH-deltamethrin	<0.1	<0.1	<0.1	<0.1
Acid moiety (^{14}C-dibromovinyl results)				
Br_2CA	4.1	3.0	4.0	0.3
t-OH-Br_2CA	0.0	0.2	0.0	0.0
Br_2CA- glyc	0.1	0.7	1.9	0.5
Br_2CA conj	1.7	4.2	12.9	7.7
Unknown-conj	<0.1	<0.1	0.4	0.2
Decomposition on HCl hydrolysis of conjugates	0.7	0.5	1.2	0.1
Unextracted	4.8	8.5	5.7	11.2
Loss	55	74	54	77
Alcohol moiety : ^{14}C-benzyl (^{14}C-cyano results in parentheses)				
*m*PB aldehyde	1.3	1.1	1.2	1.2
*m*PB alcohol	0.4	0.7	0.2	0.0
*m*PB acid	1.1	2.0	2.0	0.0
4'OH- *m*PB acid	0.1	0.1	0.0	0.0
*m*PB alcohol-conj	0.4	1.2	4.6	1.9
*m*PB acid-glyc	0.5	1.7	1.8	0.9
*m*PB acid-conj	0.8	1.5	11.4	5.9
*m*PB cy-conj	1.7 (1.4)	3.2 (1.4)	13 (24)	8.8 (8.3)
Decomposition on HCl hydrolysis of conjugates	1.0 (1.1)	1.3 (1.1)	1.9 (9.0)	0.5 (0.0)
Unextracted	3.9 (4.1)	12 (8.4)	13 (11)	24 (14)
Loss	56 (60)	66 (80)	31 (36)	54 (75)

The metabolism of deltamethrin in discs cut from leaves freshly removed from greenhouse-grown bean and cotton plants was also studied. The leaf discs 10 mm diameter were punched out under water and incubated for 5 hours at 30°C with [^{14}C]deltamethrin solutions and illuminated with artificial light. In bean leaf discs [^{14}C-dibromovinyl]deltamethrin and [^{14}C-benzyl]deltamethrin were converted in small yield (approx. 6%) to Br_2CA-glyc and *m*PB alcohol-glyc whereas in cotton leaf

discs this did not occur. When used as substrates, the cleavage products Br_2CA and *m*PB cyanide underwent more extensive metabolism than deltamethrin in both plants.

Table 12. Metabolic products (% of the TRR) of deltamethrin and its hydrolysis products in cotton and bean leaf discs (Ruzo and Casida, 1979).

Compound	Cotton disc	Bean disc
	^{14}C-dibromovinyl-deltamethrin as substrate	
Br_2CA-glyc	0.0	6.2
	^{14}C-dibromovinyl-Br_2CA as substrate	
Br_2CA-glyc	6.6	12
Br_2CA-glyc	0.4	49
Br_2CA-glyc	1.2	
Total	8.2	62
	[^{14}C-benzyl]deltamethrin as substrate	
*m*PB alcohol-glyc	0.0	6.0
	^{14}C-benzyl *m*PB cyanide as substrate[1]	
*m*PB alcohol	12	1.0
*m*PB aldehyde	5.0	2.2
*m*PB acid	1.7	0.0
*m*PB cy-glyc	0.0	0.2
*M*PBalcohol-glyc-1	23	6.0
*M*PBalcohol-glyc-2	3.0	40
*m*PB alcohol-glyc-3	1.4	2.5
*m*PB alcohol-glyc-4	4.4	2.2
*m*PB acid-glyc	3.0	2.1
Total	53	56

[1] essentially the same products and yields were reported to have been obtained with *m*PB aldehyde as the substrate

In a further study in the USA in 1989 small plots were treated with radiolabelled deltamethrin at exaggerated rates to assist metabolite identification (O'Grodnick and Larson, 1990). Cotton plants (*var.* DES119) grown outdoors in Mississippi were treated with either [^{14}C-benzyl]- or [^{14}C-*gem*-dimethyl]deltamethrin 3 months after planting and again one month later, approximately 28 days before harvest, at a rate of 0.22 kg ai/ha. Samples of leaves and stems were collected 4 and 10 days after the first application and of stems, roots, squares, burs, bolls, lint and seed at harvest.

Table 13. Distribution of ^{14}C in field-grown cotton plants treated with [^{14}C-benzyl]- or [^{14}C-*gem*-dimethyl]deltamethrin (O'Grodnick and Larson, 1990).

Sampling time	Sample	[^{14}C-*gem*-dimethyl]deltamethrin (TRR, mg eq/kg)	[^{14}C-benzyl]deltamethrin (TRR, mg eq/kg)
Post-first application	Leaves	18	12
4 days	Stems	0.49	0.68
	Roots	0.2	0.18
	Bolls	0.55	0.54
	Squares	4.2	3.5
10 days	Old leaves (bottom leaves)	7.6	7.2
	New leaves (top leaves)	7.7	7.6
	Stems	0.47	0.40
	Roots	0.081	0.076
	Bolls	0.28	0.14
	Squares	0.85	1.4
Post-second application	Leaves	30	48
Harvest	Stems	1.2	2.1
	Roots	0.15	0.24
	Lint	0.99	1.3
	Unopened bolls	0.37	0.89
	Burs	2.4	5.4
	Seeds	0.052	0.047

Analysis of cotton leaf samples collected 4 and 10 days after treatment indicated that deltamethrin and two of its isomers were the primary components (80–85% of the TRR day 4; 65-75% of the TRR day 10). Metabolites identified in the 10-day samples were *m*PB acid (6%), *m*PB alcohol (2%) and, tentatively, Br_2CA (4%). Chromatographic analysis of cotton seed extracts was extremely difficult owing to the low levels of radioactive residues. However low levels of deltamethrin and its two isomers *trans*- and α-*R*-deltamethrin were detected. When hexane, the solvent used in the analytical method, was used as the extraction solvent, 57-77% of the TRR was extracted, this compared favourably with the 58-71% extracted after the sequential extraction of cotton seed with chloroform/methanol and methanol/water.

Table 14 Characterization of ^{14}C in cotton leaves (% of the TRR) from field-grown cotton plants treated with [^{14}C-benzyl]- or [^{14}C-*gem*-dimethyl]deltamethrin (O'Grodnick and Larson, 1990).

	^{14}C-*gem* dimethyl deltamethrin		[^{14}C-benzyl]-deltamethrin	
Days after first application	4 days	10 days	4 days	10 days
Total extractable ^{14}C residue (mg equiv/kg)	10	6.8	14	6.4
Deltamethrin	61%	49%	61%	38%
α-*R*-deltamethrin	16%	12%	23%	12%
trans-deltamethrin	8.8%	15%	7.2%	15%
Unidentified	2.6%	4.1%	3.7%	28%[1]

[1] isolation of metabolites by preparative TLC and hydrolysis and characterization by TLC and HPLC indicated *m*PB acid (6.0%), *m*PB alcohol (2.1%) and a minimum of six other components ranging from 0.2 to 6.0 % of the total radioactivity.

Corn. The metabolism of [^{14}C-*gem*-dimethyl]- and [^{14}C-benzyl]deltamethrin was studied in field corn (hybrid 3751) in the USA (Periasamy *et al.,* 1994a). Two spray applications were made at a rate of 0.11 kg ai/ha six and four weeks before harvest. Samples were collected immediately after the first application (day 0), before the second application (day 14) and at harvest four weeks after the second application (day 42). Radioactive residues, quantified and characterized by HPLC and TLC, were mainly concentrated in the foliage and the husks, where desiccation also contributed to concentration of the residues (grain and cob were not directly exposed to the spray).

Table 15. Distribution of ^{14}C in field corn after foliar applications of [^{14}C-*gem*-dimethyl]- and [^{14}C-benzyl]deltamethrin (Periasamy *et al.,* 1994a).

Days after last application	Sample	TRR (mg equiv/kg)[1]	
		^{14}C-*gem* dimethyl	[^{14}C-benzyl]deltamethrin
0 (post first spray)	Forage	3.9	4.6
0 (post second application, 14 days after first)	Forage	4.1	5.0
28	Foliage	23	21
	Husk	9.2	23
	Grain	0.054	0.019
	Cob	0.017	0.006

[1] sum of extractable (methanol and in some cases acidified methanol and reflux with aqueous NaOH) and unextracted ^{14}C

Table 16. Characterization of ^{14}C in field corn after foliar application of [^{14}C-*gem*-dimethyl]- and [^{14}C-benzyl]deltamethrin (Periasamy *et al.,* 1994a).

Days after last application	Sample	Compound	^{14}C-*gem* dimethyl		^{14}C-benzyl	
			^{14}C (mg equiv/kg)	% of TRR	^{14}C (mg equiv/kg)	% of TRR
Post first Spray	Forage	deltamethrin	3.9	100	4.6	99.5
		*m*PB aldehyde			0.022	0.48
Post second Spray	Forage	deltamethrin	3.6	90	4.4	90
		trans-Br_2CA	0.023	0.57		
		4'-OH-deltamethrin	0.026	0.65	0.021	0.42

Days after last application	Sample	Compound	^{14}C-*gem* dimethyl		^{14}C-benzyl	
			^{14}C (mg equiv/kg)	% of TRR	^{14}C (mg equiv/kg)	% of TRR
		*m*PB acid			0.046	0.93
		*m*PB aldehyde			0.1	2.0
		*m*PB alcohol			0.01	0.2
		deltamethrin amide			<0.001	<0.02
		4'-OH- *m*PB alcohol			0.009	0.18
Harvest	Foliage	deltamethrin	20	87	17	80
		trans-Br_2CA	0.072	0.32		
		cis-Br_2CA	0.16	0.7		
		4'-OH-deltamethrin	0.13	0.58	0.083	0.39
		*m*PB acid			0.77	3.7
		*m*PB aldehyde			0.60	2.9
		*m*PB alcohol			0.015	0.07
		deltamethrin amide			0.24	1.2
		4'-OH-*m*PB alcohol			0.25	1.2
	Husks	deltamethrin	7.3	81	19	86
		trans-Br_2CA	0.015	0.17		
		cis-Br_2CA	0.16	1.7		
		4'-OH-deltamethrin	0.095	1.1	0.12	0.52
		*m*PB acid			1.1	4.7
		*m*PB aldehyde			0.75	3.3
		*m*PB alcohol				
		4'-OH-*m*PB alcohol			0.019	0.08

In forage, foliage and husks 80-100% of the total residues were deltamethrin or deltamethrin isomers. Minor metabolites were generally ≤0.01 mg/kg. Grain and cob contained only ≤0.06 mg/kg. A large part of the radioactivity in grain could not be extracted.

Table 17. Percentages of deltamethrin and its isomers as measured by TLC in forage, mature foliage and husks from field corn treated with foliar sprays of [^{14}C-*gem*-dimethyl]- and [^{14}C-benzyl]deltamethrin (Periasamy *et al.,* 1994a).

Sample	^{14}C-*gem* dimethyl			[^{14}C-benzyl]deltamethrin		
	α-*R*-isomer	deltamethrin	*trans*-isomer	α-*R*-isomer	deltamethrin	*trans*-isomer
Corn forage (harvest 1)	38	56	6	27	67	6
Corn forage (harvest 2)	36	54	10	21	68	11
Mature foliage	21	68	11	16	71	13
Mature corn husk	21	66	13	15	73	12

Apples. The metabolism of ^{14}C-*gem* dimethyl- and ^{14}C-benzyl-labelled deltamethrin was studied in apples. Two spray applications were made at a rate of 0.06 kg ai/ha six and four weeks before harvest to two apple trees in the USA in 1993 (Periasamy *et al.,* 1994b). Apples were sampled immediately after the first application, before the second and at harvest four weeks after the second. The apples were rinsed with methanol/water (1:1) and the radioactive residues in the rinses and washed apples quantified and characterized by HPLC and TLC.

Most of the radioactivity was associated with the apples rather than the rinses, particularly at the later harvest intervals when almost all was inside the fruit.

Table 18. Distribution of ^{14}C in apples and their surface rinses (mg eq/kg) after foliar applications of [^{14}C-*gem* dimethyl]- and [^{14}C-benzyl]deltamethrin to apple trees (Periasamy *et al*., 1994b).

Days after last application	Label	^{14}C, mg/kg as deltamethrin			
		Rinse [1]	Apples		Total
			Extractable [2]	Unextractable	
0 (Harvest 1)	^{14}C-*gem* dimethyl	0.053 (42%)	0.069	0.003	0.13
	^{14}C-benzyl	0.088 (30%)	0.19	0.008	0.29
14 (Harvest 2)	^{14}C-*gem* dimethyl	0.022 (14%	0.16	0.013	0.16
	^{14}C-benzyl	0.012 (8.6%	0.15	0.010	0.14
28 (Harvest 3)	^{14}C-*gem* dimethyl	0.019 (5.5%)	0.29	0.028	0.35
	^{14}C-benzyl	0.012 (2.6%)	0.38	0.073	0.47

[1] 1:1 methanol:water
[2] methanol for all samples, day-28 samples further extracted with 1N HCl and by reflux with 2N HCl

Deltamethrin and its isomers were the main components at all intervals accounting for 92-100% of the TRR. Deltamethrin was predominant (59-71%) with varying amounts of α-*R*- (19-34%) and *trans*–deltamethrin (5.8-19%) also present, as were several minor components at <0.01 mg/kg and <10% of the TRR (Table 19).

Table 19. Characterization of ^{14}C residues in apples and their surface rinses after foliar application of [^{14}C-*gem*-dimethyl]- and [^{14}C-benzyl]deltamethrin to apple trees (Periasamy *et al.,* 1994b).

Sample	Label	Compound	% of TRR
Rinses	^{14}C-*gem* dimethyl	*trans*-Br_2CA	ND-0.3
Rinses	^{14}C-*gem* dimethyl	*cis*-Br_2CA	ND-0.3
Rinses, apples	^{14}C-*gem* dimethyl, ^{14}C-benzyl	4'-OH-deltamethrin	ND-1.9
Rinses, apples	^{14}C-benzyl	*m*PB acid	ND-2.4
Rinses, apples	^{14}C-benzyl	*m*PB aldehyde	ND-4.8
Apples	^{14}C-benzyl	*m*PB alcohol	ND-1.8
Rinses, apples	^{14}C-benzyl	4'-OH- *m*PB alcohol	ND-0.08

88-92% of the TRR was extracted with hexane in fruit harvested on the day of the first spray, which compared well with the 100-114% extracted with methanol. In both extracts more than 99% of the radioactivity was determined to be deltamethrin.

Tomatoes. In a study in the USA in 1984 plants were sprayed with [^{14}C-*gem*-dimethyl]deltamethrin or [^{14}C-benzyl]deltamethrin at 0.05 kg ai/ha or by direct application at 14 µg/tomato in a greenhouse (Merricks and Swidersky 1985). Tomatoes were sampled at regular intervals for 28 days after application, rinsed in water and residues in both the rinses and the washed fruits quantified and characterized by TLC. Fruit treated by direct application were not rinsed before analysis.

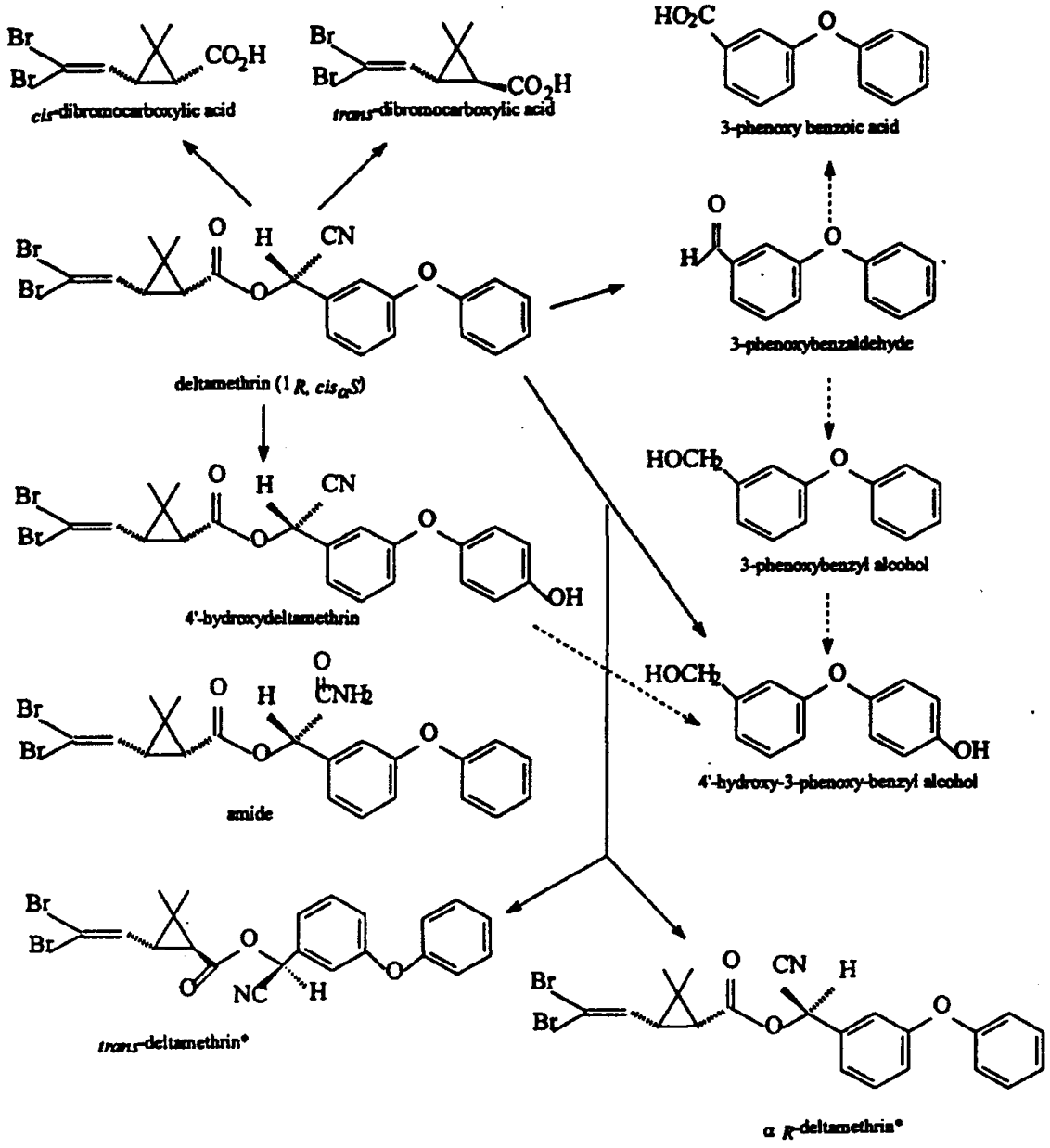
Table 20. Distribution of ^{14}C in greenhouse tomatoes (mg eq/kg) after foliar sprays or direct application to the fruit with [^{14}C-*gem*-dimethyl]deltamethrin or [^{14}C-benzyl]deltamethrin (Merricks and Swidersky, 1985).

Days after last application	Sample	^{14}C-*gem* dimethyl		[^{14}C-benzyl]-	
		Foliar spray	Direct application	Foliar spray	Direct application
4	Fruit	0.0068, 0.024	0.22, 0.20	0.041, 0.011	0.21
14	Fruit	0.025, 0.060	0.2, 0.26	0.014, 0.033	0.13, 0.15
28	Fruit	0.018, 0.027	0.12	0.016, 0.020	0.13, 0.23
28	Vines	0.416, 0.34	-	0.55, 0.66	-

After both methods of application 79-93% of the TRR in the tomatoes was deltamethrin and its isomers: the ratio was not reported as they were not separated. Minor metabolites in the fruit (0.5%) were 3-phenoxybenzamide and/or *m*PB acid, indistinguishable in the chromatographic systems used.

Metabolism studies on tomatoes, apples, maize and cotton (representative of the crop categories fruits, cereals and oilseed) demonstrated that deltamethrin was not readily degraded and that the degradation pattern was similar in all crops. The major identified products in plants are analogous to those in mammals but the conjugates differ. The proposed degradation pathways involve isomerization, hydrolysis, ester cleavage, reduction, oxidation and hydroxylation. Deltamethrin is not systemic; its translocation in plants is very limited.

Figure 2. Proposed metabolic pathways of deltamethrin in crops.



*these isomers can also enter the various degradation pathways indicated for deltamethrin.

Environmental fate in soil

Residues in rotational crops

The uptake of deltamethrin residues from soil into succeeding or rotational crops has been investigated in test plots and under field conditions (Erstfeld *et al.*, 1991).

Test plots of soil (0-15 cm depth sandy loam: 75% sand, 19% silt, 6% clay, 0.5 % OM, pH 6.1, CEC 3.9 meq/100 g, bulk density 1.69, 5.6% moisture holding capacity at 0.33 bar) were treated ten times with [^{14}C-benzyl]deltamethrin at a rate of 45 g ai/ha at seven-day intervals. 30 or 120 days after the last treatment, the soil was rototilled and rotational crops (carrots, lettuce or barley) planted for harvest at half maturity and at normal terminal harvest.

Recoveries of total radioactivity were low at all intervals, except from barley straw. No significant residues (>0.01 mg/kg) were found in the edible parts of succeeding crops, and the extracted residues contained extremely polar, unidentified material.

In another trial spinach, carrots and radishes were planted in soil sprayed once with deltamethrin at 118 g ai/ha and then thoroughly cultivated (Krebs *et al.,* 1986). Crops were sampled 28 or 42 days after soil treatment (spinach), 106 or 133 days (carrots) and 28 or 42 days (radishes). The samples were analysed by GC-ECD, and no significant residues (≥0.01 mg/kg) were found in any.

It is concluded that succeeding or rotational crops are unlikely to contain significant residues of deltamethrin.

Soil degradation

Aerobic. The degradation of deltamethrin in the dark in the laboratory using [^{14}C]deltamethrin labelled at two positions (benzyl and *gem* dimethyl) was investigated for 181 days in a US sandy loam soil (Casa Grande, HA2; sand 66%, silt 16%, clay 18%, 0.5%OM; CEC 14 meq/100 g; pH 8.1; bulk density 1.51 g/cm^3; field moisture capacity 23.4) at a concentration of 0.2 mg/kg by Wang (1991a). Characterization of the ^{14}C residues was by HPLC with UV detection and, for selected samples, by TLC, and samples were analysed after 0, 1, 3, 7, 14, 30, 59, 90, 120 and 181 days' incubation.

Degradation occurred by ester cleavage followed by oxidation and mineralisation to $^{14}CO_2$. The only major degradation product was Br_2CA from the *gem*-labelled samples representing 23% of the total applied radioactivity on day 14. The other potential major product, *m*PB acid from the benzyl-labelled samples, was not detected. Presumably once formed, *m*PB acid is not stable under aerobic conditions and is probably more susceptible to further microbial degradation than Br_2CA.

Table 21 Distribution and characterization of radioactivity in various soil fractions after aerobic degradation of [^{14}C]deltamethrin at 25°C (Wang, 1991a).

	% of applied radioactivity							
Days of incubation	0 days	7 days	14 days	30 days	59 days	91 days	120 days	181 days
[^{14}C-benzyl]deltamethrin								
% extracted [1]	94	70	51	33	15	8.6	5.7	3.7
deltamethrin	94	67	50	32	14	8.6	5.7	3.7
*m*PB acid	ND	ND	ND	ND	ND	ND	ND	ND
Br_2CA	-	-	-	-	-	-	-	-
% in PES	6.4	15	21	18	22	18	18	15
% in KOH ($^{14}CO_2$)	0.0	7.9	22	30	45	52	56	61
[^{14}C-*gem* dimethyl]deltamethrin								
% extracted	92	94	76	60	34	17	10	7.8

Days of incubation	% of applied radioactivity							
	0 days	7 days	14 days	30 days	59 days	91 days	120 days	181 days
deltamethrin	92	80	51	34	20	12	9.7	7.8
*m*PB acid	-	-	-	-	-	-	-	-
Br_2CA	ND	11	23	22	8.6	2.0	0.4	ND
% in PES	8.4	17	29	35	44	48	48	44
% in KOH ($^{14}CO_2$)	0.0	1.1	4.5	8.4	25	36	42	50

[1] with dichloromethane/acetonitrile
ND: not detected (<0.01 mg/kg)
PES: post extraction solids representing the unextracted residues
KOH: radioactivity in 0.1 or 1 mol dm^{-3} aqueous KOH trap solutions and thought to represent $^{14}CO_2$

Three unidentified transformation products were present in very small quantities (maximum 4%). At 181 days, *gem*-dimethyl- and benzyl-labelled deltamethrin were mineralised to 50% and 61% respectively to CO_2.

The unextracted residues accumulated steadily in the samples before being further mineralised to $^{14}CO_2$ and incorporated into the soil biomass. Up to 48% and 18% of the total radioactivity was detected in the unextracted residues on day 90 from the dimethyl- and benzyl-labelled deltamethrin respectively. The characterization of the unextracted residues in the 181-day samples by humus fractionation yielded an average of 9-24%, 2-4% and 4-15% of the total applied radioactivity in the humin, humic acid and fulvic acid fractions respectively for the two labelled compounds. Thus the unextracted residues were mainly associated with the humin fraction.

The half-lives of [^{14}C-benzyl]- and [^{14}C-*gem*-dimethyl]deltamethrin under the aerobic test conditions were estimated to be 22 and 25 days respectively, assuming first-order kinetics.

Anaerobic. The degradation of benzyl- and dimethyl-labelled deltamethrin in the dark was investigated in a laboratory in the same US sandy loam soil (Casa Grande, HA2) at a concentration of 0.2 mg/kg (Wang, 1991b). The soil was incubated aerobically for 15 days, then flooded with degassed deionised water and degradation monitored for the next 90 days. Soil samples were separated from the flood-water by filtration for determination of radioactivity and degradation products after 0, 30, 59 and 90 days of incubation.

Table 21. Distribution (% of TRR) and characterization of radioactive residues in various fractions after anaerobic degradation of [^{14}C]deltamethrin at 25°C (Wang, 1991b).

Fraction	[^{14}C-benzyl]deltamethrin				[^{14}C-*gem* dimethyl]deltamethrin			
	0 day	30 days	59 days	90 days	0 days	30 days	59 days	90 days
% in extract $MeCl_2$/acetonitrile	53	19	10	7.2	58	23	16	9.6
deltamethrin[1]	51	19	10	7.2	54	22	14	9.3
*m*PB acid	ND	ND	ND	ND	ND	-	-	-
Br_2CA	-	-	-	-	3.6	0.94	2.2	0.32
Unknown 4	1.3	ND	ND	ND	-	-	-	-
% in flood water	3.6	4.9	2.6	1.9	13.1	53	56	58
deltamethrin[1]	ND	ND	ND	ND	ND	ND	ND	ND
*m*PB acid	ND	ND	3.0	ND	-	-	-	-
Br_2CA	-	-	-	-	ND	34	35	35
Unknown 3	ND	ND	ND	ND	ND	3.4	2.1	3.9
% in post-extraction solids	28	23	20	17	25	22	18	18
% in KOH ($^{14}CO_2$)	16	47	63	71	3.9	7.2	8.9	13

[1] Under the reverse-phase HPLC conditions used it was not possible to resolve α-*R*-deltamethrin from deltamethrin. However, the formation of small amounts of α-*R*-deltamethrin (1-2% of the applied radioactivity at 59 days) was confirmed by chromatography of the pyrethroid region of the reverse-phase HPLC eluate by normal-phase HPLC with the inclusion of an internal standard
ND: not detected (<0.01 mg/kg)

Three transformation products were detected.

1. α-*R*-deltamethrin from the epimerization of deltamethrin. A minor metabolite representing not more than 1 to 2% of the total applied radioactivity in the day-59 extracts.
2. Br_2CA from the dimethyl-labelled samples representing 52% of the total applied radioactivity on day 59.
3. *m*PB acid from the benzyl-labelled samples which was detected at a maximum of 3% in the day 30 samples.

Four unidentified minor transformation products were also observed in very small quantities (maximum 4%).

At the end of the 90-day incubation 13% and 71% of the dimethyl- and benzyl-labelled deltamethrin was mineralized respectively to CO_2.

The unextracted residues accumulated steadily in the samples before being further mineralised to $^{14}CO_2$ and incorporated into the soil biomass. About 17% of the total radioactivity was detected in the post-extraction solids on day 90 from both the [^{14}C-*gem*-dimethyl]- and [^{14}C-benzyl]deltamethrin, and humus fractionation yielded an average of 7-9%, 3% and 5-8% of the total applied radioactivity in the humin, humic acid and fulvic acid fractions respectively.

The half-lives of deltamethrin were estimated to be 32 and 36 days for the [^{14}C-benzyl]- and [^{14}C-*gem*-dimethyl]deltamethrin respectively assuming first-order kinetics.

Degradation occurred via epimerization of the pyrethroid moiety followed by ester cleavage, oxidation and mineralization to $^{14}CO_2$ and its incorporation into the soil biomass.

Baedelt *et al.* (1990) applied an EC formulation of deltamethrin at a rate of 38 g ai/ha to soil at four different field locations in Germany using a plot sprayer. Samples of soil from the 0-20 cm layer were collected before and immediately after spraying and at various intervals afterwards up to 5 months for analysis of the residues by GC-CIMS.

Table 22. Deltamethrin residues in soil at intervals after application at 38 g ai/ha to four fields in Germany (Baedelt *et al.,* 1990).

Days after application	Deltamethrin (mg/kg)			
	Stelle	Bornheim	Gersthofen	Fmf-Schwanheim
Before	0.001	<0.001	<0.001	<0.001
0	0.015	0.014	0.021	0.006
7	0.008	0.011	0.011	0.010
14	0.005	0.005	0.006	0.008
28-31	0.005	0.005	0.001	0.005
56-61	0.004	0.002	0.002	0.003
84-91	0.003	0.001	<0.001	0.001
140-153	0.004	0.001	<0.001	0.001
286-313	0.003	0.001	0.001	<0.001
377-392	0.002	<0.001	<0.001	0.001
Half-life	29 days	17 days	17 days	23 days
Soil type	Silty sand	Sandy loam	Loamy sand	Sandy silty loam

Analytical recoveries from soil samples fortified at 0.001 mg/kg were 85, 112, 99 and 122%; at 0.003 mg/kg, 90%; at 0.005 mg/kg; 89, 110 and 116%, at 0.1 mg/kg; 112, 92 and 114%, at 0.03 mg/kg; 72, 98, 102 and 102%; and at 0.1 mg/kg 87%.

The dissipation and mobility of deltamethrin and its isomers as well as Br_2CA was studied in a corn field in Minnesota, USA by Mayasich and Czarnecki (1991a). Ten applications of an EC formulation of deltamethrin were made to two plots (each 6 × 37 m) at 6- to 10-day intervals. Except for the last application at 0.11 kg ai/ha, the rate was 0.045 kg ai/ha. One of the plots was cropped with

field corn (Pioneer 3733) while the other was maintained as bare ground. An untreated cropped control plot was also included. The surface soil, 0-15 cm, was a loamy sand (79% sand, 12% silt, 9.2% clay, pH 5, %OM 2.2, CEC 15 meq/100 g, field moisture 9.6%, bulk density 1.26 g/cm^3). Residues of deltamethrin and its isomers *trans*-deltamethrin and α-*R*-deltamethrin, as well as the potential degradation product Br_2CA, were monitored in the soil to a maximum of 90 cm depth for 118 days after the last application. Rainfall and irrigation during the study amounted to approximately 53 cm.

The only compounds detected were deltamethrin and α-*R*-deltamethrin, the latter only in a single sample 1 day after the last of application.

Table 23. Residues in soil cores of cropped and bare ground plots after ten applications of an EC formulation of deltamethrin to a corn field, with the last application at 0.11 kg ai/ha (Mayasich and Czarnecki, 1991a).

Days after last application	Plot	Compound	Concentration (mg/kg)			
			0-15 cm	15-30 cm	30-45 cm	45-60 cm
Pre-10th Application	Cropped	Deltamethrin	0.013	ND	ND	ND
	Bare	Deltamethrin	0.015			
0	Cropped	Deltamethrin	0.019			
	Bare	Deltamethrin	0.041	0.004	0.003	
1	Cropped	α-R-deltamethrin	0.002			
		Deltamethrin	0.027	0.003		
	Bare	Deltamethrin	0.016	0.004	0.003	
3	Cropped	Deltamethrin	0.021			
	Bare	Deltamethrin	0.026	0.006	0.002	
7	Cropped	Deltamethrin	0.019	0.002		
	Bare	Deltamethrin	0.028	0.003	0.002	0.003
14	Cropped	Deltamethrin	0.015			
	Bare	Deltamethrin	0.011	0.003		
28	Cropped	Deltamethrin	0.006			
	Bare	Deltamethrin	0.015			
60	Cropped	Deltamethrin	0.009			
	Bare	Deltamethrin	0.008			
90	Cropped	Deltamethrin	0.006			
	Bare	Deltamethrin	0.006			
118	Cropped	Deltamethrin	0.007			
	Bare	Deltamethrin	0.010			

The estimated half-life of deltamethrin on the cropped plot was about 14 days and on the bare ground plot 69 days.

In an identical experiment in a cotton field in Louisiana, USA (Mayasich and Czarnecki 1991b) one of the plots was cropped with cotton (Deltapine 41) and the other maintained as bare ground. An untreated cropped control plot was also included. The surface soil, 0-15 cm, was characterized as a loam (28% sand, 48% silt, 24% clay, pH 6.6, %OM 0.7, CEC 11 meq/100 g, field moisture 15%, bulk density 1.22 g/cm^3). Residues of deltamethrin, *trans*-deltamethrin, α-*R*-deltamethrin and Br_2CA were monitored in the soil to a maximum of 90 cm depth for 150 days after the last application. Rainfall and irrigation during the study amounted to approximately 114 cm.

The only compounds detected were deltamethrin and α-*R*-deltamethrin, the latter only in a few samples at very low levels.

Table 24. Residues in soil cores of cropped and bare ground plots after ten applications of an EC formulation of deltamethrin to a cotton field, with the last application at 0.11 kg ai/ha (Mayasich and Czarnecki 1991b).

Days after last application	Plot	Compound	Concentration (mg/kg)			
			0-15 cm	15-30 cm	30-45 cm	45-60 cm
Pre-10th application	Cropped	α-*R*-deltamethrin	0.004	ND	ND	ND
		Deltamethrin	0.043	ND	ND	ND
	Bare ground	Deltamethrin	0.012	ND	ND	ND
0	Cropped	α-*R*-deltamethrin	0.004	ND	ND	ND
		Deltamethrin	0.053	ND	ND	ND
	Bare	α-R-deltamethrin	0.002	ND	ND	ND
		Deltamethrin	0.018	ND	ND	ND
1	Cropped	Deltamethrin	0.027	ND	ND	ND
	Bare	Deltamethrin	0.017	ND	ND	ND
3	Cropped	Deltamethrin	0.028	ND	ND	ND
	Bare	Deltamethrin	0.024	ND	ND	ND
7	Cropped	Deltamethrin	0.027	ND	ND	ND
	Bare	Deltamethrin	0.021	ND	ND	ND
14	Cropped	Deltamethrin	0.042	ND	ND	ND
	Bare	Deltamethrin	0.025	ND	ND	ND
30	Cropped	Deltamethrin	0.017	ND	ND	ND
	Bare	Deltamethrin	0.010	ND	ND	ND
60	Cropped	α-*R*-deltamethrin	0.004	ND	ND	ND
		Deltamethrin	0.038	ND	ND	ND
	Bare	Deltamethrin	0.015	ND	ND	ND
90	Cropped	Deltamethrin	0.068	ND	ND	ND
	Bare	Deltamethrin	0.009	ND	ND	ND
121	Cropped	α-*R*-deltamethrin	0.004	ND	ND	ND
		Deltamethrin	0.041	ND	ND	ND
	Bare	α-*R*-deltamethrin	0.002	ND	ND	ND
		Deltamethrin	0.013	ND	ND	ND
150	Cropped	Deltamethrin	0.044	ND	ND	ND
	Bare	Deltamethrin	0.015	ND	ND	ND

It was not possible to estimate a half-life for the degradation of deltamethrin because of the variability in the concentration with time. Deltamethrin residues did not appear to be degraded significantly during the 150 days of the study.

The hydrolytic degradation of [^{14}C]deltamethrin (1:1 mixture of [^{14}C-benzyl]- and [^{14}C-*gem*-dimethyl]deltamethrin) in water at pH 5, 7 and 9 was studied by Smith (1990). At pH 5 and 7 there was no appreciable degradation of deltamethrin when maintained at 25°C under sterile conditions for 30 days in the dark, and at pH 9 it was unstable with a half-life of 2.5 days. Two degradation products were identified: *m*PB aldehyde and traces of Br_2CA.

Abiotic hydrolysis is unlikely to contribute significantly to the degradation of deltamethrin residues in aquatic systems unless the pH is high.

Aqueous photolysis

The aqueous photolysis of deltamethrin was studied in the laboratory in sterile water at pH 7, using ^{14}C-*gem*-dimethyl- and ^{14}C-benzyl-labelled test material (Wang and Reynolds, 1991). Deltamethrin (30 µg/l) was irradiated for 30 days, with a 12 h light/12 h dark photoperiod, by polychromatic light from a Xenon arc lamp. The wavelengths were in the range of 330 to 800 nm and the light flux around 166 W/m^2. The lamp intensity was shown to be comparable to that of average New Jersey, USA, sunlight.

After 21 days of irradiation, less than 1% of the applied radioactivity could be detected in the volatile traps indicating minimal losses by volatilization. Deltamethrin and its isomers *trans*- and α-*R*-deltamethrin accounted for 86% of the applied ^{14}C for the benzyl label compared to 90% in the dark control, and for the *gem*-dimethyl label for 88% in both the irradiated and dark control samples.

During the irradiation, deltamethrin underwent ester cleavage and *cis-trans* isomerization. The major photodegradation products were *m*PB acid and *cis*-Br_2CA. *Trans*-deltamethrin was also found in the day 14 and day 30 extracts.

Adsorption/desorption

The adsorption constants of deltamethrin were determined in four US standard soils (Arizona I (sandy loam; 80% sand, 9% silt, 11% clay, 0.6% OM, pH 8.5, CEC 10 meq/100 g), Arizona II (sandy loam; 66% sand, 17% silt, 17% clay, 0.24% OM, pH 8.1, CEC 15 meq/100 g), Arizona III (clay; 32% sand, 25% silt, 43% clay, 0.24% OM, pH 7.6, CEC 24 meq/100 g) and Mississippi (silty clay loam; 14% sand, 47% silt, 39% clay, 0.8% OM, pH 6.5, CEC 17 meq/100 g) by batch equilibrium studies at a nominal deltamethrin concentration of 1.4-14.2 µg/l in 0.01 M $CaCl_2$ solution (Smith, 1990). The K_d values ranged from 3,790 to 30,000, the K_{oc} from 460,000 to 16,300,000, and their log values from 5.7 to 7.2. The adsorption and desorption characteristics of deltamethrin did not vary much in the four soils and the compound can be considered as immobile.

Table 25. Adsorption constants for deltamethrin in four US standard soils.

Soil	K_d	% OM	K_{OC}	log K_{OC}	1/n	Correlation coefficient
AZI	9 600	0.0588	16 300 000	7.2	0.77	0.949
AZII	30 000	0.235	12 800 000	7.1	1.2	0.971
AZIII	26 700	0.235	11 400 000	7.1	0.74	0.954
MS	3 790	0.824	460 000	5.7	1.0	0.986

The degradation of deltamethrin in soil is primarily a biotic process with a half-life of about 25 days at 25ºC. The main degradation pathway is ester cleavage followed by oxidation. Deltamethrin is extensively mineralised under aerobic conditions, with up to 60% of the applied ^{14}C being released as $^{14}CO_2$ after 6 months. Deltamethrin is not expected to accumulate in soil after repeated application.

The very low water solubility and high log P_{OW} of deltamethrin would indicate a very low potential for transport in soil via water movement. This is confirmed by laboratory adsorption/desorption studies and measurements in the field.

Biological degradation

Wüthrich (1994) studied the biodegradation of deltamethrin (100 mg/l) stored for 28 days at 22°C in the dark in flasks containing suspensions of activated bacterial sludge (30 mg suspended solid/l). The biochemical oxygen demand was monitored and samples were analysed chemically after 28 days. The concentration of deltamethrin in the test solutions was 74-84% of the starting value, and in the control flasks containing 100 mg aniline/l approximately 79% of the aniline had been degraded. Deltamethrin did not affect the microbial activity as in a separate experiment the degradation of aniline was not affected by deltamethrin. The test indicated that deltamethrin is not readily biodegradable under these conditions.

The biodegradability of [^{14}C-benzyl]deltamethrin was assessed at two sites in water/sediment systems consisting of 20 g dry soils (Kromme Rijn 13% clay, 16% silt, 71% sand, pH 7.5, 3.0% OM, CEC 11 meq/100 g, and TNO ditch 26% clay, 38% silt, 37% sand, pH 7.1, 12% OM, CEC 36 meq/100 g) suspended in 200 ml of water and pre-incubated for 14 days at 20°C in the dark (Muttzall, 1993). Deltamethrin was then added to give an initial concentration of 0.14 mg/l. Carbon dioxide was

collected in 10 M NaOH traps. After various periods radioactive residues in the water and sediment were extracted for characterization by HPLC and TLC.

The radioactivity in the aqueous phase decreased from an initial mean of about 37% to 0% after 4 weeks. Up to about 30% of the total radioactivity was detected as $^{14}CO_2$ after twelve weeks of incubation.

The mean extractable radioactivity in the sediments increased from an initial value of about 60% to 76-82% after two days and decreased to 33-58 % at the end of 12 weeks, while the unextracted radioactivity increased steadily from ≤1% to 8-17% during the 12 weeks.

Table 26. Distribution of ^{14}C from [^{14}C]deltamethrin after incubation with TNO water/sediment system (% of applied ^{14}C) (Muttzall, 1993).

Incubation (days)	$^{14}CO_2$ [1]	H_2O [2]	Extractable in sediment	Unextractable in sediment	Total recovery
0	ND, ND	23, 51	78, 46	1.0, 1.0	103, 98
0.25	0.0, 0.0	26, 26	59, 54	1.1, 0.9	86, 82
1	0.1, 0.1	26, 26	61, 80	1.5, 2.1	88, 108
2	0.1, 0.1	19, 20	74, 78	1.9, 1.6	95, 99
4	0.5, 0.5	22, 17	67, 78	2.3, 2.4	92, 98
7	0.8, 1.0	20, 16	68, 73	5.4, 7.5	94, 97
14	8.2, 13	4.3, 3.5	72, 67	7.4, 12	92, 96
28	25, 27	0.0, 0.0	49, 46	19, 16	93, 89
56	31, 25	0.0, 0.0	40, 46	20, 18	92, 89
84	27, 31	0.0, 0.3	35, 32	16, 19	78, 82

[1] radioactivity collected in CO_2 traps plus ^{14}C as $^{14}CO_2$ in the aqueous phase (after 14 days)
[2] (total radioactivity minus $^{14}CO_2$ radioactivity) in the aqueous phase

Table 27. Distribution of ^{14}C from [^{14}C]deltamethrin after incubation with Kromme Rijn water/sediment system (% of applied ^{14}C) (Muttzall, 1993).

Incubation (days)	$^{14}CO_2$ [1]	H_2O [2]	Extractable in sediment	Unextractable in sediment	Total recovery
0	ND, ND	37, 39	61, 58	0.1, 0.1	99, 97
0.25	0.0, 0.0	36, 21	47, 58	0.1, 0.7	83, 80
1	0.1, 0.0	14, 11	86, 86	0.3, 0.3	101, 97
2	0.2, 0.1	9.3, 12	77, 86	1.3, 0.4	88, 98
4	0.4, 0.3	8.0, 12	91, 86	0.7, 1.5	100, 100
7	1.1, 0.9	6.1, 12	88, 81	1.6, 1.7	97, 96
14	6.1, 8.8	4.1, 0.5	84, 86	2.4, 2.8	96, 98
28	12, 12	0.3, 0.2	75, 77	6.2, 6.7	94, 96
56	18, 20	0.0, 0.0	74, 69	5.1, 5.4	97, 95
84	22, 20	0.0, 0.3	59, 57	6.6, 8.9	88, 86

[1] radioactivity collected in CO_2 traps plus ^{14}C as $^{14}CO_2$ in the aqueous phase (after 14 days)
[2] (total radioactivity minus $^{14}CO_2$ radioactivity) in the aqueous phase

Table 28. Evolution of deltamethrin and α–R isomer in extracts of the sediments as a percentage of the initial radioactivity (Muttzall, 1993).

Incubation (days)	TNO water-sediment system		Kromme Rijn water-sediment system	
	deltamethrin	α-R-deltamethrin	deltamethrin	α-R-deltamethrin
0	73	5	56	2
0.25	53	6	47	0
1	67	11	75	10
2	59	12	71	13
4	54	19	72	16
7	39	21	66	19

Incubation (days)	TNO water-sediment system		Kromme Rijn water-sediment system	
	deltamethrin	α-R-deltamethrin	deltamethrin	α-R-deltamethrin
14	54	11	56	24
28	22	15	52	16
56	32	8	51	17
84	29	16	38	14

The half-life of deltamethrin ranged from 2 to 8 weeks, depending upon the water/sediment system. The major compounds found after 12 weeks of incubation were the parent and α-*R* deltamethrin (45 to 52%). Minor amounts of *m*PB acid and 4'-OH-*m*PB acid and amide were tentatively identified from a comparison of retention times with authentic standards. The degradation pathways of deltamethrin in water/sediment systems involved ester cleavage and isomerization.

Abiotic hydrolysis is only expected to occur in waters with high pH values. Indirect photochemical transformation of deltamethrin may occur but is considered a minor degradation route. Biodegradation in aquatic environments is expected to be rather slow. Deltamethrin will mainly be distributed to suspended organic material, biota and eventually to sediments.

METHODS OF RESIDUE ANALYSIS

Seven different analytical methods have been reported for the determination of deltamethrin and its isomers *trans*- and α-*R*-deltamethrin in plant material and animal feeds. All these are based upon similar principles, with variations introduced because of improved techniques and technologies over the years, for example solid-phase extraction (SPE) cartridges for extract clean-up, and capillary gas chromatography. The basic approach employs extraction by homogenization with an organic solvent mixture incorporating varying proportions of polar and non-polar solvents depending primarily upon the nature of the sample and its water content. In general, a primary liquid-liquid partition follows extraction, to transfer deltamethrin residues to less polar solvents before column clean-up. In all cases residues are finally determined by gas chromatography with an electron capture detector. The resolution of individual isomers (*trans*- and α-*R*-deltamethrin) depends on the column used, modern DB-1, DB-5 and DB-17 phases increasing resolution.

The seven methods are summarised in Table 29. In some the determination of metabolites in plant material is also outlined.

Table 29. Summary of major analytical methods used for the determination of deltamethrin in various samples.

Method, (reference)	Sample material	Extraction solvent	Clean-up	% recovery and fortifications	LOQ (mg/kg)
Deltamethrin residue analysis (Mestres *et al*., 1979)	More than 40 different crops (deltamethrin)	1) acetonitrile 2) 50:50 mixture petroleum ether-diethyl ether	Florisil Florisil	67-100% at 0.02 mg/kg 70-100% at 0.5 mg/kg	0.01-0.05
AL40/79 (Their, 1979)	All plant material except hops (deltamethrin)	Methanol + acetonitrile + water	Florisil with toluene as mobile phase	80-100 % at 0.010 mg/kg	0.01
HUK 169/40 (Benwell, 1992)	Beans (deltamethrin)	Water + acetonitrile + hexane	-	70-120 % at 0.05 mg/kg	0.05
HRAV-7 (Bixler, 1990)	Tomatoes (deltamethrin + trans-isomer)	Hexane	Gel permeation + alumina	72.5-115.5 % 0.02-0.2 mg/kg	0.02
RESID/96/10 (Snowdon and Taylor, 1996)	Peaches (deltamethrin)	Acetone	Silica gel	94% 0.05-0.5 mg/kg	0.05

Method, (reference)	Sample material	Extraction solvent	Clean-up	% recovery and fortifications	LOQ (mg/kg)
ENC-6/92 (Baldi and McKinney, 1994)	Processed grain, grain dust, whole grains of wheat, corn, sorghum and rice. (deltamethrin + trans- and α-R-isomers)	Hexane/acetone (1:1)	Gel permeation + alumina column	120% at 0.02 mg/kg (grain) and 0.05 mg/kg (dust)	0.02 (grain) 0.05 (dust)
HRAV-7 (Czarnecki *et al.*, 1990; Crotts *et al.*, 1991)	Cotton seed + processing fractions (deltamethrin + trans-isomer)	Hexane	Gel permeation + alumina column	Average recovery 87–93% at 0.02-4 mg/kg for all substrates	0.02

An analytical method (HRAV-22, ENC 3-/93) for the determination of deltamethrin and its isomers α-*R*- and *trans*-deltamethrin has been validated in dairy cow and poultry samples and covers muscle, liver, kidney, fat, eggs and milk (Huff and McKinney, 1994). Determination of the compounds is by GC-ECD after extraction with a 1:1 mixture hexane/acetone and clean-up by gel-permeation chromatography followed by purification on an alumina column using a 85:15 mixture hexane/dichloromethane in the mobile phase. The limits of quantification are 0.05 mg/kg for animal fat and 0.02 mg/kg for all other tissues and fluids. The mean recoveries from all substrates ranged from 87 to 93% at fortifications of 0.05 to 0.75 mg/kg for fat and 0.015 to 0.15 mg/kg for all other substrates.

Table 30. Validation data for the determination of deltamethrin in bovine milk, cream, liver, kidney, muscle and fat and chicken muscle, liver, fat and eggs (Huff and McKinney, 1994).

Sample	Fortification (mg/kg) [1]	Recovery (%)
Whole milk	0.015 0.075 0.15	96, 89 89, 86 93, 92
Cream	0.015 0.045 0.075 0.375 0.75	91, 105 93, 90 88, 96 81, 88 90, 100
Beef muscle (tenderloin)	0.015 0.075 0.15	82, 84 81, 99, 97, 95 92, 98
Beef liver	0.015 0.075 0.15	89, 87 83, 88 87, 87
Beef kidney	0.015 0.075 0.15	84, 91 78, 81 74, 110
Beef fat	0.045 0.075 0.15 0.375 0.75	113, 65 100, 94 97, 89 96, 90 88, 81, 96
Chicken muscle	0.015 0.075 0.15	94, 88 97, 98 98, 70
Chicken liver	0.015 0.075 0.15	93, 87 91, 93 100, 95
Chicken fat	0.045 0.075 0.15	87, 87, 90 105, 83 92, 104
Eggs	0.015 0.075 0.15	86, 119 86, 88 76, 86, 96, 97

[1] fortification levels are for the sum of equal amounts of deltamethrin, trans- and α-*R*-deltamethrin, e.g. 0.15 mg/kg comprises 0.05 mg/kg of each

A method described by Akhtar (1982) for the determination of deltamethrin residues in animal tissues involved homogenization with water/acetone (1:5) and extraction with hexane. The hexane extract is cleaned up by gel permeation chromatography and analysed by GC-ECD. The method was shown to give satisfactory recoveries of 67-95% for all samples spiked at 0.01 to 0.1 mg/kg. The limit of quantification is 0.01 mg/kg.

Milk samples are extracted with hexane and the extract partitioned with acetonitrile. The solvent is evaporated to dryness, and the sample redissolved and analysed by GC-ECD. Recoveries from fortifications of 0.01 to 0.1 mg/kg were in the range 70-94%. The limit of quantification is 0.01 mg/kg.

Table 31. Validation data for the determination of deltamethrin in bovine milk, liver, kidney, muscle and fat (Akhtar, 1982).

Sample	Fortification (mg/kg)	Recovery (%)[1]	
		GLC method	Radioactivity
Milk	0.1	83-87	99-102
	0.05	80-89	96-97
	0.01	67-72	93-94
Liver	0.1	83-89	92-94
	0.05	67-75	93-95
	0.01	68-73	78-81
Kidney	0.1	82-91	93-102
	0.05	81-87	87-89
	0.01	70-78	93-94
Muscle	0.1	88-95	88-89
	0.01	83-94	93-95
Fat	0.1	80-86	102-104
	0.01	75-79	93-103

[1] corrected using recoveries from deltamethrin solutions without biological material as a standard to account for losses of 21-29% occurring during extraction and clean-up steps

The GLC conditions used in the method above do not resolve deltamethrin and α-*R*-deltamethrin.

Soil

In a method for residue analysis (Benwell, 1992) soil samples were extracted with water/hexane/acetonitrile with clean-up of the extracts by diol "Bond Elut" cartridge with diethyl ether + hexane (10 + 90) as mobile phase. The residues were determined by GLC with an ECD. Recoveries of deltamethrin from fortified soil samples were 70 and 72% at 0.001 mg/kg, 88 and 87% at 0.01 mg/kg and 113 and 79% at 0.05 mg/kg.

Grigor (1991) reported a method for the determination of deltamethrin, *trans*-deltamethrin and Br_2CA in soil. The residues are extracted with 1:1 hexane/acetone. An aliquot is cleaned up on a silica gel cartridge and residues of deltamethrin and *trans*-deltamethrin determined by GLC with an ECD. Br_2CA is determined by derivatization of a separate aliquot using pentafluorobenzyl bromide followed by GLC with an ECD (different GLC conditions from those for deltamethrin and *trans*-deltamethrin). Recoveries from soil samples fortified at 0.002 mg/kg were 115, 89 and 96% for deltamethrin and 94, 72 and 76% for *trans*-deltamethrin, and from samples fortified with Br_2CA at 0.01 mg/kg 104, 84 and 90%.

Water (including drinking water)

An analytical method based on solvent extraction with a mixture of petroleum ether and diethyl ether (1:1), clean-up by column chromatography on Florisil and determination by GC-ECD is reported by

Mestres *et al.* (1979). Recovery of deltamethrin from natural water was 97% from a sample fortified at 0.01 mg/kg and 96% from water from cooked vegetables fortified at 0.002 mg/kg.

Multi-residue enforcement method

In a method of analysis (DGM F01/97-0) for deltamethrin and endosulfan described together with validation data by Martens (1998a) samples are extracted with acetone followed by dichloromethane/petroleum ether (1:1). After centrifugation and clean-up by gel permeation chromatography and mini silica gel column, deltamethrin residues are determined by GC–ECD.

Recovery experiments were conducted at 0.02 mg/kg and 0.2 mg/kg for each sample, with the results shown in Table 32.

Table 32. Validation data for method DGM F01/97-0 for the determination of deltamethrin in various crops (Martens, 1998a).

Sample	Fortification (mg/kg)	Mean recovery (%)	RSD (%)[1]	No.
Potato (tuber)	0.02 0.2	102 100	6.8 10	5 5
Peach (fruit)	0.02 0.2	107 111	8.2 5.5	5 5
Onion (bulb)	0.02 0.2	104 93	12 3.9	5 5
Rape (seed)	0.02 0.2	110 112	7.7 5.6	5 5
Cucumber (fruit)	0.02 0.2	99 91	8.0 6.2	5 5
Orange (peel)	0.02 0.2	90 94	5.8 6.9	5 5
Orange (pulp)	0.02 0.2	87 93	5.1 12	5 5
Melon (peel)	0.02 0.2	109 105	7.6 6.7	5 5
Melon (fruit)	0.02 0.2	102 97	4.0 11	5 4
Tomato (fruit)	0.02 0.2	101 108	6.5 4.2	5 5

[1] relative standard deviation RSD: SD/Mean recovery

The method DGM F01/97-0 was also validated for dry grain crops but using acetone/dichloromethane/petroleum ether (1:1:1) as extractant (Martens, 2000). Wheat grain samples fortified at 0.02 mg/kg gave a mean recovery of 90% (RSD 10%, n = 6) while samples fortified at 1.0 mg/kg gave 104% (RSD 14%; n = 6). The limit of quantification was 0.02 mg/kg.

The method was also validated by an independent laboratory (Xenos Laboratories Inc., Ottawa, Canada) for plant and animal samples (Haines and Tauber, 2001). The samples were lettuce, oranges, cattle milk and pork fat and fortification levels were 0.02 and 0.2 mg/kg. Overall mean recoveries and percentage RSDs in lettuce and oranges were 101 ± 13% and 87 ± 15%, and in milk and pork fat 89 ± 14% and 94 ± 21% respectively. The recoveries are shown in Table 33.

Table 33. Independent laboratory validation data for method DGM F01/97-0 for the determination of deltamethrin in crop and animal commodities (Haines and Tauber, 2001).

Crop	Fortification (mg/kg)	Mean recovery (%)	RSD (%)*	No.
Lettuce	0.02	105	8.2	5
	0.2	98	16	5
Orange	0.02	91	16	4
	0.2	84	15	5
Pork fat	0.02	109	13	5
	0.2	79	15	5
Milk	0.02	90	13	5
	0.2	84	14	5

Czarnecki *et al.* (1990) reported validation data for the determination of deltamethrin and *trans*-deltamethrin using analytical method HRAV-7 in cotton seed and its processed commodities. The method involves extraction with cyclohexane or hexane and clean-up by gel permeation chromatography followed by passage through an alumina column. The residue is analysed by GLC with ECD (Novak, 1985). Validation was carried out on samples of cotton seed, hulls, soapstock and oil fortified at levels ranging from 0.02 to 2.0 mg/kg.

Table 34. Validation data for method HRAV-7 for the determination of deltamethrin and *trans*-deltamethrin in various cotton seed commodities (Czarnecki *et al.,* 1990).

Sample	Deltamethrin		*trans*-deltamethrin	
	Fortification (mg/kg)	Recovery (%)	Fortification (mg/kg)	Recovery (%)
Cotton seed	0.02	113	0.02	91
	2.0	95	2.0	92
Cotton seed hulls	0.02	104	0.02	93
	0.1	83	0.1	73
	0.5	86	0.5	82
Cotton seed soapstock	0.02	80	0.02	77
	0.1	74	0.1	79
	1.0	99, 91	1.0	93, 107
Cotton seed crude oil	0.02	83	0.02	90
	0.1	86	0.1	91
	0.5	89	0.5	80

Bixler (1990a) reported the validation of analytical method HRAV-7 for Mexican cherry tomatoes. Samples were fortified with deltamethrin or *trans*-deltamethrin at 0.02 or 0.2 mg/kg. Recoveries of deltamethrin were 88% at 0.02 mg/kg and 77 and 115% at 0.2 mg/kg, and of *trans*-deltamethrin 95% at 0.02 mg/kg and 73% at 0.2 mg/kg.

The validation of method RESID/96/10 for the determination of deltamethrin residues in peaches was described by Snowden and Taylor (1996). Residues are extracted from peaches using acetone and ultrasonic disruption, partitioned into dichloromethane and cleaned up on a silica SPE cartridge before determination by GLC with an ECD. Recoveries from samples fortified at 0.05 mg/kg were 90, 88 and 90% and at 0.5 mg/kg 92, 91 and 114%.

Baldi and McKinney (1994) reported the validation of a GLC method for the determination of deltamethrin and its isomers *trans*- and α-*R*-deltamethrin in selected processed grain fractions and dusts, and in whole grain from maize, wheat, sorghum and rice. The method involves extraction of residues with hexane/acetone (or hexane for soapstock), clean-up by gel permeation chromatography followed by passage through a neutral alumina column, and determination by GLC with an ECD. Mean recoveries were within acceptable limits (Table 35).

Table 35. Validation data for the determination of deltamethrin, α-*R*- and *trans*-deltamethrin in various cereal grains and process fractions (Baldi and McKinney, 1994).

Sample	Fortification (mg/kg)	Recovery (%)		
		α-R-deltamethrin	deltamethrin	*trans*-deltamethrin
Whole maize (dry mill)	0.02	99, 104	99, 99	96, 98
	0.5	100, 100	99, 97	92, 90
	10	89, 79	88, 76	84, 72
Maize meal (dry mill)	0.02	119, 112	117, 109	112, 107
	0.5	102, 118	101, 115	95, 105
	10	82, 86	78, 85	75, 78
Maize flour	0.02	116, 104	120, 111	121, 108
	0.2	77, 93, 69, 110	76, 96, 83, 113	75, 94, 99, 115
	2.0	88, 79	89, 79	87, 78
Maize grits (dry mill)	0.02	111, 102	114, 102	119, 108
	0.5	95, 101	95, 101	96, 101
	10	115, 106	115, 107	116, 106
Maize starch (wet mill)	0.02	103, 107	102, 104	104, 106
	0.5	85, 119	83, 117	78, 115
	10	78, 78	78, 76	74, 72
Refined maize oil (dry mill)	0.02	98, 75	95, 78	106, 88
	0.5	103, 100	103, 97	96, 94
	10	96, 88	93, 87	90, 82
Maize soapstock (dry mill)	0.02	94, 81	99, 81	98, 75
	0.5	105, 102	101, 100	99, 95
	10	96, 99	93, 98	90, 93
Maize dust	0.05	94, 84	92, 81	94, 84
	0.5	95, 94	91, 96	95, 94
	100	88, 84	87, 83	88, 84
Whole wheat grain	0.02	119, 102	116, 98	113, 95
	0.5	95, 85	94, 83	86, 76
	10	82, 81	78, 77	73, 71
Wheat flour	0.02	98, 113, 97	100, 113, 99	99, 114, 98
	0.5	110, 110	109, 111	109, 111
	10	93, 118	93, 115	93, 117
Wheat middlings	0.02	101, 110	99,107	87, 98
	0.5	92, 102	89, 101	83, 97
	10	100, 96	97, 95	93, 89
Wheat shorts	0.02	111, 122	109, 121	99, 111
	0.5	85, 96	87, 96	84, 89
	10	93, 88	91, 86	86, 82
Wheat bran	0.02	94, 111	85, 111	82, 112
	0.5	112, 99	112, 97	110, 101
	10	98, 101	97, 99	97, 101
Wheat dust	0.05	113, 126	114, 123	117, 123
	0.5	87, 91	84, 89	82, 86
	100	85, 96	85, 94	81, 85
Whole grain sorghum (wet mill)	0.02	101, 112	101, 114	95, 108
	0.5	97, 93	94, 92	84, 83
	10	82, 102, 97, 104	79, 101, 94, 102	74, 98, 91, 98
Sorghum starch (wet mill)	0.02	106, 100	104, 99	106, 100
	0.5	86, 87	85, 87	84, 85
	10	89, 71	90, 70	87, 68
Sorghum flour (dry mill)	0.02	95, 106	94, 103	94, 104
	0.5	95, 103	92, 101	85, 97
	10	96, 106	94, 103	90, 100
Sorghum dust	0.05	95, 85	94, 84	87, 78
	0.5	98, 106	93, 104	88, 98
	100	90, 116, 109, 91	84, 110, 106, 88	73, 99, 98, 82
Rough rice (paddy rice)	0.02	104, 100, 112	102, 100, 113	96, 93, 107
	0.5	95, 94	91, 88	83, 82
	5.0	86, 100	82, 96	77, 93
Polished rice	0.02	116, 112	118, 114	115, 110
	0.5	99, 95	98, 95	97, 93

Sample	Fortification (mg/kg)	Recovery (%)		
		α-R-deltamethrin	deltamethrin	*trans*-deltamethrin
	10	83, 93	83, 92	82, 89
Rice hulls	0.02	113, 113	103, 103	103, 105
	0.5	101, 85	101, 85	92, 79
	10	90, 80	90, 77	88, 71

Stability of pesticide residues in stored analytical samples

Fuchsbichler (1990) studied the storage stability of residues in green and dried hops, beer and spent hops fortified at nominal levels of 0.5, 2.0, 0.1 and 1.0 mg/kg respectively and stored in glass flasks with ground glass stoppers. The percentages remaining after storage at -20°C for 5.5 months were 105%, 116%, 86% and 81% for green and dried hops, beer and spent hops respectively. Details of analytical recoveries were not provided.

The storage stability of chopped samples of lettuce fortified with deltamethrin or its *trans*-isomer and stored in glass jars at –15°C for up to 16.5 months was determined by Grigor (1990, 1991, Table 36).

Table 36. Freezer storage stability of deltamethrin and *trans*-deltamethrin in fortified chopped lettuce samples (Grigor, 1990, 1991).

Storage, months	Concentration (mg/kg)	Procedural recovery %
deltamethrin		
0	0.90, 0.90	
3	0.58, 0.70	86, 68
9.75	0.89, 1.2, 1.1	73, 91
16.5	0.59, 0.66, 0.66	111, 113
trans-deltamethrin		
0	0.92, 0.72	
3	0.78, 0.76	78, 88
9.75	1.1, 1.0, 1.1	75, 109
16.5	1.1, 0.78, 1.0	92, 89

McKinney (1993) studied the storage stability of deltamethrin and the isomers *trans*- and α-*R*-deltamethrin in fortified samples of various grains, fractions and dusts stored in glass bottles at –20°C, 20°C and 30°C and in acetone at ambient temperature (Tables 37-40).

Table 37. Stability of deltamethrin, α-*R*- and *trans*-deltamethrin in fortified grain commodities stored at –20°C (McKinney, 1993).

Storage, days	α-R-deltamethrin		deltamethrin		*trans*-deltamethrin	
	Concentration (mg/kg)	Procedural recovery (%)	Concentration (mg/kg)	Procedural recovery (%)	Concentration (mg/kg)	Procedural recovery (%)
Corn grain						
0	0.52, 0.48	99, 107	0.45, 0.54	100, 108	0.51, 0.49	101, 109
264	0.36, 0.35	99, 97	0.38, 0.42	97, 96	0.42, 0.42	94, 94
Corn meal						
0	0.43, 0.45	95, 91	0.45, 0.50, 0.51	96, 90, 108	0.36, 0.39	91, 88
276	0.47	99, 104	0.44, 0.42	99, 101	0.48, 0.44	96, 102
283	0.37, 0.34	92, 97		90, 94		89, 90
Corn oil						
0	0.57, 0.54	106, 118	0.58, 0.52	103, 117	0.52, 0.53	101, 117
273	0.49, 0.49	113, 101	0.46, 0.47	109, 97	0.47, 0.46	109, 94
Corn flour						
0	0.46, 0.47	91, 111	0.52, 0.50	88, 112	0.44, 0.42	80, 110
262	0.36, 0.40	92, 87	0.44, 0.42	89, 86	0.39, 0.38	89, 86

Storage, days	α-R-deltamethrin		deltamethrin		*trans*-deltamethrin	
	Concentration (mg/kg)	Procedural recovery (%)	Concentration (mg/kg)	Procedural recovery (%)	Concentration (mg/kg)	Procedural recovery (%)
Whole rice						
0	0.38, 0.47	89, 102	0.49, 0.50	85, 102	0.48, 0.42	79, 98
164	0.39, 0.41	100, 108	0.41, 0.29	98, 105	0.23, 0.36	96, 105
252	0.39, 0.43	89, 95	0.42, 0.40	90, 93	0.41, 0.45	90, 93
Whole sorghum						
0	0.44, 0.45	96, 106	0.48, 0.47	96, 105	0.48, 0.44	96, 104
273	0.46, 0.46	98, 113, 91, 102	0.41, 0.45	97, 114, 92, 103	0.40, 0.42	97, 106, 90, 96
Wheat dust						
0	22, 22	99, 89	21, 23	99, 89	27, 24	98, 89
284					22	81
Wheat grain						
0	0.41, 0.47	101, 87	0.53, 0.45	101, 83	0.53, 0.45	97, 78
264	0.40, 0.43	87, 86	0.44, 0.39	89, 88	0.44, 0.49	87, 85

Table 38. Stability of deltamethrin, α-*R*- and *trans*-deltamethrin in fortified grain commodities stored at 20°C (McKinney, 1993).

Storage, days	*α*-R-deltamethrin		deltamethrin		*trans*-deltamethrin	
	Concentration (mg/kg)	Procedural recovery (%)	Concentration (mg/kg)	Procedural recovery (%)	Concentration (mg/kg)	Procedural recovery (%)
Corn grain						
0	0.52, 0.51		0.52, 0.50		0.51, 0.46	
33		123, 113	0.39, 0.47	122, 111		117, 105
89		86, 74	0.42, 0.39	84, 72		82, 71
180		98, 90	0.27, 0.32	95, 87		99, 90
278		92, 96	0.43, 0.37	90, 95		90, 96
369		92, 95	0.45, 0.40	90, 95		91, 93
Wheat grain						
0	0.58, 0.57		0.59, 0.58		0.58, 0.0.56	
34		99, 106	0.42, 0.40	98, 107		94, 104
90		83, 76	0.43, 0.40	79, 74		72, 69
181		72, 80	0.21, 0.31	71, 78		69, 79
279		99, 113	0.48, 0.50	98, 116		96, 112
366		78, 86	0.29, 0.29	76, 86		73, 85
Sorghum grain						
0	0.55, 0.54		0.55, 0.54		0.55, 0.55	
29		109, 106	0.44, 0.45	106, 103		99, 97
89		106, 84	0.33, 0.36	102, 81		100, 77
194		87	0.38, 0.34	89		91
280		100, 97	0.38, 0.41	100, 96		97, 94
371		95, 124	0.34, 0.36	95, 120		89, 116
Rice grain						
370		91, 101	0.18, 0.21	91, 102		91, 97

Table 39. Stability of deltamethrin, α-*R*- and *trans*-deltamethrin in fortified grain commodities stored at 30°C (McKinney, 1993).

Storage, days	*α*-R-deltamethrin		deltamethrin		*trans*-deltamethrin	
	Concentration (mg/kg)	Procedural recovery (%)	Concentration (mg/kg)	Procedural recovery (%)	Concentration (mg/kg)	Procedural recovery (%)
Corn grain						
0	0.52, 0.51		0.52, 0.50		0.51, 0.46	
33		128, 99	0.36, 0.36	125, 96		117, 88
89		88, 105	0.33, 0.38	86, 104		85, 102
180		78, 64	0.24, 0.34	76, 62		77, 64

Storage, days	α-R-deltamethrin		deltamethrin		*trans*-deltamethrin	
	Concentration (mg/kg)	Procedural recovery (%)	Concentration (mg/kg)	Procedural recovery (%)	Concentration (mg/kg)	Procedural recovery (%)
278		98, 99	0.45, 0.40	96, 99		93, 97
Rice grain						
0	-	-	-	-	-	-
28		68, 104	0.39, 0.40	67, 101		68, 95
90		101, 74	0.25, 0.24	101, 74		102, 94
194		102, 58	0.12, 0.17	106, 61		96, 60
281		106, 107	0.22, 0.21	103, 106		99, 100
370		98, 101	0.13, 0.13	98, 99		94, 93
Wheat grain						
0	0.58, 0.57		0.59, 0.58		0.58, 0.0.56	
34		108, 117	0.47, 0.45	109, 117		108, 116
90		85, 78	0.37, 0.37	82, 76		77, 70
181		91, 75	0.17, 0.23	88, 73		87, 73
279		93, 114	0.34, 0.37	93, 113		90, 111
366		86, 93	0.33, 0.27	86, 92		82, 87
Sorghum grain						
0	0.55, 0.54		0.55, 0.54		0.55, 0.55	
29		92, 90	0.40, 0.37	88, 88		81, 84
89		93, 98	0.28, 0.28	91, 96		91, 98
194		99, 98	0.39, 0.35	103, 101		104, 102
280		90, 99	0.35, 0.33	89, 97		89, 94
371		109, 101	0.32, 0.26	103, 98		100, 92

There was no significant conversion of deltamethrin to *trans*- or α-*R*-deltamethrin in any of the storage conditions (-20, 20 or 30°C).

Table 40. Stability of deltamethrin in acetone stored at ambient temperature (McKinney, 1993).

Storage, days	Concentration (µg/500 ml)	% of isomer	
	deltamethrin	α-*R*-deltamethrin	*trans*-deltamethrin
0	1.1, 1.1	[1]	*
0	13, 12	[1]	*
3	0.81, 1.0	[1]	*
3	10, 12	<2%`	<2%
7	0.78, 0.96	[1]	*
7	11, 10	<2%	<2%

[1] visual inspection of chromatograms indicated <10% conversion to either α-*R*- or *trans*-deltamethrin

There was also no significant conversion of deltamethrin to *trans*- or α-*R*-deltamethrin when acetone solutions were stored at ambient temperature for 7 days.

McKinney and Clayton (1995) studied the stability of tralomethrin (results not reported here), deltamethrin, and *trans*- and α-*R*-deltamethrin in cotton seed and its processed commodities stored in glass bottles at -20°C (Table 41).

Table 41. Stability of deltamethrin, *trans*- and α-*R*-deltamethrin in fortified samples of cotton seed commodities stored at –20°C (McKinney, 1995).

Storage, days	α-*R*-deltamethrin		deltamethrin		*trans*-deltamethrin	
	Concentration (mg/kg)	Procedural recovery (%)	Concentration (mg/kg)	Procedural recovery (%)	Concentration (mg/kg)	Procedural recovery (%)
Cotton seed						
0	0.20, 0.19		0.20, 0.22		0.19, 0.17	
185			0.17, 0.18	95	0.17, 0.11	87
244	0.22, 0.15	76				

Storage, days	α-*R*-deltamethrin		deltamethrin		*trans*-deltamethrin	
	Concentration (mg/kg)	Procedural recovery (%)	Concentration (mg/kg)	Procedural recovery (%)	Concentration (mg/kg)	Procedural recovery (%)
349			0.20, 0.19	109	0.18, 0.17	83
436	0.14, 0.14	78				
493			0.15, 0.18	89	0.16	89
583	0.16, 0.15	94				
735			0.22, 0.22	121	0.21, 0.19	99
1160			0.18, 0.15	103	0.16, 0.18	101
Cotton seed hulls						
0	0.21, 0.16		0.21, 0.22		0.18, 0.16	
182			0.11, 0.14	75	0.12, 0.06	61
244	0.15, 0.21	94	0.12, 0.13	104	0.11, 0.14	83
392			0.17, 0.12	75	0.12, 0.12	73
436	0.10, 0.10	80				
585	0.12, 0.11	89				
Cotton seed crude oil						
0	0.19, 0.17		0.19, 0.19		0.16	
190			0.19, 0.21	113	0.16	79
236	0.21, 0.21	69				
405			0.19, 0.18	99	0.16, 0.17	79
426	0.19, 0.22	92				
450	0.20, 0.22	114				
586	0.21, 0.22	92				
727			0.20, 0.19	106	0.17, 0.16	84
Cotton seed soapstock						
0	0.16, 0.15		0.19, 0.19		0.15, 0.17	
210			0.15, 0.15	82	0.13, 0.10	74
236	0.21, 0.23	93				
398			0.16, 0.17	107	0.22, 0.16	73
442	0.20, 0.18	107				
593	0.14, 0.16	93				
732					0.18, 0.20	82
775			0.20, 0.20	84		

Rose (1985) determined the frozen storage stability of tralomethrin (not reported here) and deltamethrin in soya bean seeds. The storage temperature was not specified.

Table 42. Stability of deltamethrin in samples of fortified soya bean seeds stored frozen (Rose, 1985).

Storage	0.02 mg/kg fortification		0.1 mg/kg fortification	
	Concentration (mg/kg)	% procedural recovery	Concentration (mg/kg)	% procedural recovery
0 months	0.017, 0.015		0.09, 0.0876	
3 months	0.022, 0.023		0.089, 0.097	
6 months	0.016, 0.018	121, 131	0.0969, 0.1016	88, 130
9 months	0.014, 0.015	58, 75	0.0859, 0.0586	82, 58
12 months	0.015, 0.017	82, 85	0.0595, 0.0487	70, 71

Williams (2000) determined the stability of deltamethrin and the isomers *trans*- and α-*R*-deltamethrin in two cabbage samples with field-incurred residues stored in a laboratory freezer at -10 to -20°C.

Table 43. Stability of α-*R*-deltamethrin, deltamethrin and *trans*-deltamethrin in cabbage with field-incurred residues stored at –20°C (Williams, 2000).

Storage, days	α-*R*-deltamethrin		deltamethrin		*trans*-deltamethrin	
	Concentration (mg/kg)	Procedural recovery (%)	Concentration (mg/kg)	Procedural recovery (%)	Concentration (mg/kg)	Procedural recovery (%)
Cabbage1						
0	0.03, 0.03	165	0.49, 0.39	165	0.06, 0.05	170
330	0.02, 0.02	105, 110	0.47, 0.42	110, 110	0.06, 0.04	110, 115
449	0.02, 0.02	60, 85	0.45, 0.30	65, 90	0.06, 0.04	70, 90
639	0.03, 0.03	125, 130	0.45, 0.38	125, 130	0.06, 0.06	130, 135
643	0.03, 0.03	120, 120	0.42, 0.39	120, 120	0.05, 0.06	120, 125
722	0.04, 0.04	135, 105	0.45, 0.40	110, 95	0.06, 0.06	125, 110
Cabbage2						
0	0.01, 0.02	65	0.18, 0.25	60	0.02, 0.03	65
328	0.01, 0.01	105, 110	0.23, 0.26	110, 110	0.02, 0.03	110, 115
447	0.01, 0.01	60, 85	0.19, 0.18	65, 90	0.02, 0.02	70, 90
637	0.02, 0.02	125, 130	0.21, 0.28	125, 130	0.03, 0.03	130, 135
641	0.02, 0.02	120, 120	0.21, 0.25	120, 120	0.03, 0.03	120, 125
720	0.02, 0.02	135, 105	0.17, 0.21	110, 95	0.02, 0.03	125, 110

The stability of deltamethrin in homogenized cherry tomatoes was reported by Czarnecki *et al.* (1992) after the frozen storage of samples fortified with tralomethrin (not reported here), deltamethrin and *trans*-deltamethrin in glass bottles in a laboratory freezer at -23 to -27°C.

Table 44. Stability of deltamethrin and *trans*-deltamethrin in fortified tomatoes stored frozen (Czarnecki *et al.,* 1992).

Storage, days	Deltamethrin		*trans*-deltamethrin	
	Concentration (mg/kg)	Procedural recovery (%)	Concentration (mg/kg)	Procedural recovery (%)
0	0.19, 0.22		0.15, 0.16	
172	0.17, 0.18	86	0.19, 0.19	100
388	0.16, 0.15	78	0.13, 0.16	58
731	0.16, 0.18	80	0.19, 0.15	81

McKinney (1994) studied the frozen storage stability of tralomethrin (not reported here) and deltamethrin, including isomers, in samples of poultry tissues stored frozen at -12°C to -27°C for a maximum of 13 months.

Table 45. Stability of α-*R*-deltamethrin, deltamethrin and *trans*-deltamethrin in fortified poultry samples and eggs (McKinney, 1994).

Storage, months	Deltamethrin[1]		Deltamethrin equivalents[2]	
	Concentration (mg/kg)	% procedural recovery	Concentration (mg/kg)	% procedural recovery
eggs				
0	0.12, 0.14		0.13, 0.11	
13	0.16, 0.16	89, 02	0.16, 0.14	96, 103
muscle				
0	0.11, 0.15		0.14, 0.13	
11	0.16, 0.13	90, 81	0.13, 0.13	89, 79
liver				
0	0.17, 0.13		0.16, 0.15	
11	0.17, 0.18	105, 90	0.17, 0.18	91, 111
fat				
0	0.13, 0.13		0.12, 0.11	
12	0.13, 0.12	111, 124	0.16, 0.16	91

[1] fortified with 0.05 mg/kg deltamethrin, 0.05 mg/kg *trans*-deltamethrin and 0.05 mg/kg α-*R*-deltamethrin, total 0.15 mg/kg deltamethrin isomers

[2] samples fortified with 0.05 mg/kg tralomethrin, 0.05 mg/kg *trans*-deltamethrin and 0.05 mg/kg α-*R*-deltamethrin, total approx. 0.15 mg/kg deltamethrin equivalents

In summary, under deep freeze conditions, there was no significant (>30%) degradation of deltamethrin in any of the fortified samples.
The storage periods were

- hops and beer 5.5 months
- lettuce 16 months
- cotton seed products 13-38 months
- grain 9 months
- soya bean seed 9 months
- cabbage 24 months
- tomato 24 months
- poultry tissues and eggs 11-13 months
-
-

Definition of the residue

Deltamethrin and its isomers *trans*- and α-*R*-deltamethrin were the only major residues (≥0.05 mg/kg) detected in plant metabolism studies. The pattern of degradation was similar in all studied crops (apple, field corn, tomato and cotton) which are representative of the categories fruits, cereal grains and oilseeds.

The main identified products of deltamethrin metabolism in plants are analogous to those in animals but the conjugates differ. The proposed degradation pathways involve isomerization, hydrolysis, reduction, oxidation and hydroxylation.

It is concluded that the studies give sufficient information to define the relevant residue in plants as the sum of deltamethrin and its isomers (α-*R*- and *trans*-deltamethrin).

Deltamethrins were also the main components of the residue in animal tissues although the studies did not resolve the isomers. The definition of the residue for animal tissues, eggs and milks should be the same as for plants, the sum of deltamethrin and its isomers (α-*R*- and *trans*-deltamethrin).

The residue is fat-soluble.

USE PATTERN

The information reported to the Meeting on registered uses is summarized in Tables 46 and 47.

Table 46. Registered pre-harvest uses of deltamethrin (all foliar applications).

Crop	Country	Form.	Application			PHI (days)
			Rate (g ai/ha)	Spray concentration (g ai/hl)	No.	
Agricultural crops (locust)	Philippines	EC		1.6-4.7		1
Alfalfa	Argentina	EC	1.5-2 1.2-1.6 1.5-2			14 14 14
Alfalfa	Belarus	EC	13-25			30
Alfalfa	Chile	EC	5-7.5			14
Alfalfa	France	EC EG	6.3 6.3			21 21

Crop	Country	Form.	Application			PHI (days)
			Rate (g ai/ha)	Spray concentration (g ai/hl)	No.	
Alfalfa	Italy	EC	13 12 15 6.3			15 20
Alfalfa	Jordan	EC	1.3-2.5			3
Alfalfa	Kazakhstan	EC	13–25			30
Alfalfa	Moldova	EC	13			30
Alfalfa	Namibia	EC		0.63	1-2	3
Alfalfa	New Zealand	EC	6.2			21
Alfalfa	Peru	EC	13			1
Alfalfa	Poland	EC TB	7.5			7
Alfalfa	Romania	EC	10			
Alfalfa	Russian Federation	EC	13			30
Alfalfa	Spain	EC ULV	 7.5-13	0.75-1.3		7 7
Alfalfa	Ukraine	EC	13-25			30
Alfalfa	Uruguay	EC	2.2-5.6			14
Alfalfa (seed production only)	Canada	EC	10-14	3.3-6.9	1	20 (90gr[1])
Alfalfa (seed production)	Bulgaria	EC	15			-
Alfalfa (seed)	Czech Republic	EC (grd+air) EW SC	5-13			-?
Almond	Bulgaria	EC		1		7
Almond	France	EC EG		0.75-1.8 0.75-1.8		14 14
Apple	Argentina	EC		0.38-0.5 0.4-0.5		7 7
Apple	Austria	EC		0.5-1.8		14
Apple	Belarus	EC	13-25			30
Apple	Belgium	EG	3-12	0.7-1	2-5	7
Apple	Brazil	EC (grd+air)		1		11
Apple	Bulgaria	EC		0.75		7
Apple	Canada	EC	7.5-13	0.25-0.43	1-3	1
Apple	Chile	EC		0.2-0.65		25
Apple	China	EC		1-1.7	1-3	5
Apple	Czech Republic	EC EW		1	1	28?
Apple	France	EC EG		0.75-1.8 0.75-1.8		7 7
Apple	Greece	EC, WG		0.88-2.3		15
Apple	Hungary	EC	7.5		1-4	3
Apple	Ireland	EC	7.5	0.75		-
Apple	Italy	EC		0.75-1.9 0.75-1.8 0.85-2.2 0.75-2.5 0.63-1.3		3 3 20
Apple	Jordan	EC	7.5-19			20
Apple	Kazakhstan	EC	13–25			30
Apple	Kenya	EC	13	1.3		1
Apple	Korea	EC		1	1-3	14
Apple	Moldova	EC	12-25			30
Apple	Namibia	EC SC	6.3-11 7.5-22	0.25-0.63 0.3-0.63	1-2	7 14
Apple	Netherlands	EC, SC	5-7.5	0.3-0.75	1-3	7
Apple	Portugal	EC		1.3 0.75		21 7

Crop	Country	Form.	Application			PHI (days)
			Rate (g ai/ha)	Spray concentration (g ai/hl)	No.	
				0.75		14
Apple	Romania	EC		0.063-1.3		
Apple	Russian Federation	EC	5-7.5			30
Apple	South Africa	TB	5.5-8.5	0.25	1-2	14
Apple	Sweden	EC EG	13-15	0.63-0.75		
Apple	Turkey	EC		0.13-0.38		3
Apple	Ukraine	EC	13-25			30
Apple	UK	EC, EG	8.8	1.3	1-3	
Apple	Uruguay	EC	8.4-17	0.56-0.84		3
Apricot	France	EC EG		0.75-1.8 0.75-1.8		7 7
Apricot	Greece	EC, WG		0.88-2.3		15
Apricot	Italy	EC		0.75-1.9 0.75-1.8 0.85-2.2 0.63-1.3		3 20
Artichoke	Argentina	EC EC TB		1.13 1.2 1-1.5		4
Artichoke	France	EC	7.5			3
Artichoke	Spain	EC		0.75-1.3		7
Asparagus	Belgium	EC SC	7.5-13	1.9-3.1	1-3	7
Asparagus	Canada	EC	10	2-5		Do not apply before cutting of spears
Asparagus	France	EC EC EC EG	7.5 7.5-13 13 7.5-13			7 - 3 -
Asparagus	Italy	EC		0.75-1.3 0.75-1.2 0.63		3 20
Asparagus	Netherlands	EC, SC	7.5		1-2	7
Asparagus	Peru	EC	13			1
Asparagus	Thailand	EC		1.5-3		7
Avocado	New Zealand	EC		2.5		non-bearing plants
Balm, lemon	Russian Federation	EC	5			30
Banana	Malaysia	EC	14		1-10	3
Banana	Philippines	EC		0.93-1.6		1
Banana	Taiwan	EC	7.5			Last spray at fruiting
Barley	Argentina	EC	3.8 4			7 14
Barley	Belarus	EC	5-6.3			20
Barley	Belgium	EC SC	5	2	1-4	7
Barley	Canada	EC	4-10	1.8-10	1-3	40 (1gr^2)
Barley	Canada	EC (air)	4-10	10-68	1-2	40 (1gr)
Barley	Italy	EC	7.5-13 7.5-12 8.5-15 7.5-13 6.3			3 7 20
Barley	Kazakhstan	EC	5-6.3			20
Barley	Kenya	EC	10	2.5		1
Barley	Moldova	EC	5-6.3			20
Barley	Netherlands	EC	6.3		1-2	28

Crop	Country	Form.	Application			PHI (days)
			Rate (g ai/ha)	Spray concentration (g ai/hl)	No.	
Barley	Poland	EC	6-7.5 6.3-10			21
Barley	Portugal	EC	6.3 7.5-13	0.75-1.3		21
Barley	Russian Federation	EC	6.3			20
Barley	Ukraine	EC	5-6.3			20
Barley	UK	EC, EG	5-6.3 5		1-4[3] 1[4]	
Barley	Uruguay	EC	3.3-5.6			14
Bean, kidney	Brazil	EC (grd+air) TB		0.75 1		1
Beans	Argentina	EC EC TB		1 1 1-1.5		3
Beans	Belgium	EC SC	7.5-13	2.5-4.2	1-3	7
Beans	Brazil	EC (grd+air) SC	3-4 3-4			16
Beans	Bulgaria	EC	10			30
Beans	Chile	EC	5-10			7
Beans	Colombia	TB	10	2.5		15
Beans	Costa Rica	EC (grd+air)	12			8
Beans	Dominican Republic	EC	12 5-7.5	1.9-2.5		1
Beans	France	EC EC EG	7.5 13 13			7 7 7
Beans	Greece	EG WG		0.88-1.9 1.5		3
Beans	Guatemala	EC TB	5-7.5	1.9-2.5		1
Beans	Italy	EC		0.75-1.3 0.75-1.2 0.75-1.3 0.63		3 3 20
Beans	Malaysia	EC	14		1-10	3
Beans	Mauritius	EC	2.1-11			
Beans	Mexico	EC	5-7.5			1
Beans	Namibia	EC (grd+air)	6.3		1-2	7
Beans	Netherlands	EC, SC	7.5		1-2	7
Beans	New Zealand	EC	9.9	0.99		3
Beans	Norway	EG		1.9-3.8		14
Beans	Peru	EC TB	13-20	 5		1
Beans	Poland	EC	6.3-7.5			7
Beans	Portugal	EC		1.3 1.3		3 2
Beans	South Africa	TB (grd+air)	4.5-5			7
Beans	Venezuela	EC	8.8-13 10			5
Beans	Vietnam	EC	10			3
Beans (broad, field, tic)	UK	EC, EG	7.5		1-2	-
Beans, broad	Ireland	EC	7.5			1
Beans, broad and field	Sweden	EC	7.5-10			
Beans, French	Ireland	EC	7.5			1
Beans, mung	Australia	EC UL	14			7
Beans, navy	Australia	EC UL	14			7

Crop	Country	Form.	Application			PHI (days)
			Rate (g ai/ha)	Spray concentration (g ai/hl)	No.	
Beans, runner	Ireland	EC	7.5			1
Beans, yard long	Thailand	EC		0.75-1.5		7
Beet, fodder	France	EC EC EG	7.5 5-6.3 5-6.3			21 14 14
Beet, fodder	Netherlands	EC, SC	7.5-13			-
Beet, sugar	Belarus	EC	6.3-13			20
Beet, sugar	Bulgaria	EC	5-13			30
Beet, sugar	Chile	EC	5-10			7
Beet, sugar	Finland	EC	5-10			7
Beet, sugar	Greece	EC WG	8.8-15	 0.88-1.5		30
Beet, sugar	Italy	EC	 7.5-13	0.75-1.2 0.85-1.5 0.63		3 20 3
Beet, sugar	Kazakhstan	EC	6.3-13			20
Beet, sugar	Moldova	EC	6-13			20
Beet, sugar	Netherlands	SC	13		1-2	-
Beet, sugar	Russian Federation	EC	6.3-13			20
Beet, sugar	Spain	EC ULV	 7.5-13	0.75-1.3		35
Beet, sugar	Sweden	EC	7.5			
Beet, sugar	Syrian Arab Republic	EC	6.3-7.5			7
Beet, sugar	Turkey	EC	6.3			3
Beet, sugar	United Arab Emirates	EC	6.3-7.5			7
Beet, sugar	UK	EC, EG	7.5 7.5		 1-2	- 3
Beet, sugar and fodder	Netherlands	EC, SC	7.5		1-2	-
Beetroot	Finland	EC	5-10			7
Beetroot	France	EC EC EC EG	7.5 5-7.5 13 5-7.5			15 7 3 7
Beetroot	Sweden	EC EG	7.5-10			5
Beets	Dominican Republic	EC	6.3	3.1		1
Beets	Morocco	EC	7.5			
Beets	Norway	EG		1.9-3.8		14
Beets	Poland	EC	5-10			7
Beets	Romania	EC	13			
Beets, sugar	Portugal	EC	11			-
Bhindi	India	EC	10-15			1
Black pepper	Malaysia	EC	5		1-6	14
Blackberry						
Blackberry	Netherlands	EC, SC	5-6	0.5	1-2 1-3 G	7 7G
Blueberries	Canada	EC	6.3-7.5	0.41-7.5		14
Brassica sp.	Netherlands	EC, SC	7.5			7
Brassica sp.	New Zealand	EC	9.9	0.99		3
Brassica sp.	Spain	EC		0.75-1.3		7
Brassicas	Finland	EC TB	5-7.5			7
Brassicas	Ireland	EC	7.5			1
Broccoli	Australia	EC	11-14	1.1-1.4		2
Broccoli	Belgium	EC	7.5-13	0.75-4.2	1-3	7

Crop	Country	Form.	Application			PHI (days)
			Rate (g ai/ha)	Spray concentration (g ai/hl)	No.	
		SC				
Broccoli	Brazil	EC (grd+air)		0.75		3
Broccoli	Canada	EC	7.5-10	1.4-4.2		3
Broccoli	Dominican Republic	EC	6.3 5-7.5	3.1 1.9-2.5		1
Broccoli	El Salvador	EC	5-7.5	1.9-2.5		1
Broccoli	Guatemala	EC TB	5-7.5	1.9-2.5		1
Broccoli	Honduras	EC	5-7.5	1.9-2.5		1
Broccoli	Netherlands	EC, SC	7.5		1-3	7, 7G
Broccoli	Norway	EG		1.9-3.8		14
Broccoli	UK	EC, EG	3.8-7.5 7.5		4	- 3
Brussels sprouts	Australia	EC	11-14	1.1-1.4		2
Brussels sprouts	Belgium	EC SC	7.5-13	0.75-4.2	1-3	7
Brussels sprouts	Canada	EC	7.5-10	1.4-4.2		1
Brussels sprouts	Netherlands	EC, SC	7.5		1-3	7, 7G
Brussels sprouts	Portugal	EC		1.3		3
Brussels sprouts	Sweden	EC EG	7.5-10			5
Brussels sprouts	UK	EC, EG	3.8-7.5 7.5		4	- 3
Bulb vegetables	Spain	EC		0.75-1.3		7
Cabbage	Argentina	EC EC TB		1 1 1-1.5		3
Cabbage	Australia	EC	11-14	1.1-1.4		2
Cabbage	Belarus	EC	7.5			20
Cabbage	Belgium	EC SC	7.5-13	0.75-4.2	1-3	7
Cabbage	Brazil	EC (grd+air)		0.75		2
Cabbage	Bulgaria	EC	13-18			7
Cabbage	Canada	EC	7.5-10	1.4-4.2		3
Cabbage	China	EC	11.3-15		1-3	7
Cabbage	Costa Rica	EC (grd+air)	12			8
Cabbage	Dominican Republic	EC	6.3-12 5-7.5	1.9-2.5		1
Cabbage	El Salvador	EC	5-7.5	1.9-2.5		1
Cabbage	France	EC EC EC EG	7.5 5-7.5 13 5-7.5			7 7 3 7
Cabbage	Greece	EC, WG		0.88-1.9		7
Cabbage	Guatemala	EC TB	5-7.5	1.9-2.5		1
Cabbage	Honduras	EC	5-7.5	1.9-2.5		1
Cabbage	Indonesia	EC		1		10
Cabbage	Italy	EC		0.75-1.3 0.75-1.2 0.75-1.5 0.75-1.3 0.63		3 3 20
Cabbage	Kazakhstan	EC	7.5			20
Cabbage	Malaysia	EC	28		1-12	3
Cabbage	Mauritius	EC	2.1-11			
Cabbage	Moldova	EC	7.5			20

Crop	Country	Form.	Application			PHI (days)
			Rate (g ai/ha)	Spray concentration (g ai/hl)	No.	
Cabbage	Netherlands	EC, SC	7.5		1-3	7, 7G
Cabbage	Netherlands	EC, SC	7.5			7
Cabbage	Norway	EG		1.9-3.8		14
Cabbage	Peru	EC	13			1
Cabbage	Poland	EC	5-7.5			7
Cabbage	Portugal	EC		0.75		2
Cabbage	Russian Federation	EC	7.5			20
Cabbage	Sweden	EC EG	7.5-10			5
Cabbage	Ukraine	EC	7.5 6.3-8.8			20 30
Cabbage	UK	EC, EG	3.8-7.5 7.5		 4	- 3
Cabbage	Venezuela	EC	8.8-13 13-16			5
Cabbage	Zimbabwe	EC, SC		2.5	1-2	3
Cabbage and other crucifiers	Philippines	EC		1.6 1.3-1.6		1
Cacao	Brazil	EC (grd+air)	5-6.5			30
Cacao	Indonesia	EC		1		10
Cacao	Philippines	EC		0.93-1.6		1
Cape gooseberries	Australia	EC UL		1.4		1
Carambola	Taiwan	EC	18-20		3-4	6
Caraway	Finland	EC	5-10			7
Caraway	Netherlands	EC, SC	5		1-2	7
Carrot	Belarus	EC	7.5			20
Carrot	Belgium	EC SC	7.5-13	1.2-3.1	1-3	7
Carrot	Czech Republic	EC EW	5			-
Carrot	Finland	EC TB	5-10			7
Carrot	Greece	EC WG		1.5		15 7
Carrot	Italy	EC		0.75-1.3 0.75-1.2 0.85-1.5 0.75-1.3 0.63		3 3 20
Carrot	Kazakhstan	EC	7.5			20
Carrot	Moldova	EC	7.5			20
Carrot	Norway	EG		1.9-3.8		14
Carrot	Poland	EC	6.3-7.5			7
Carrot	Russian Federation	EC	7.5			20
Carrot	Sweden	EC EG	7.5-10			5
Carrot	Ukraine	EC	7.5			20
Carrot	Venezuela	EC EC (grd+air)	8.8-13 10-15			5 -
Cashew nut	Brazil	EC (grd+air) SC	5 5			7
Cassava	Nigeria	EC	7.5			-
Cauliflower	Argentina	EC EC TB		1.1 1.2 1-1.5		3
Cauliflower	Australia	EC	11-14	1.1-1.4		2
Cauliflower	Belgium	EC	7.5-13	0.75-4.2	1-3	7

Crop	Country	Form.	Application			PHI (days)
			Rate (g ai/ha)	Spray concentration (g ai/hl)	No.	
		SC				
Cauliflower	Brazil	EC (grd+air)		0.75		3
Cauliflower	Canada	EC	7.5-10	1.4-4.2		3
Cauliflower	Dominican Republic	EC	6.3 5-7.5	3.1 1.9-2.5		1
Cauliflower	El Salvador	EC	5-7.5	1.9-2.5		1
Cauliflower	Greece	EC		0.88-1.9		7
Cauliflower	Guatemala	EC TB	5-7.5	1.9-2.5		1
Cauliflower	Honduras	EC	5-7.5	1.9-2.5		1
Cauliflower	Mauritius	EC	2.1-11			
Cauliflower	Netherlands	EC, SC	7.5		1-3	7, 7G
Cauliflower	Norway	EG		1.9-3.8		14
Cauliflower	Peru	EC	13			1
Cauliflower	Sweden	EC EG	7.5-10			5
Cauliflower	UK	EC, EG	3.8-7.5 7.5		4	- 3
Cauliflower	Venezuela	EC	8.8-13 13-16			5
Celery	Dominican Republic	EC	5-7.5	1.9-2.5		1
Celery	El Salvador	EC	5-7.5	1.9-2.5		1
Celery	Guatemala	EC	5-7.5	1.9-2.5		1
Celery	Honduras	EC	5-7.5	1.9-2.5		1
Celery	Ireland	EC	7.5			1
Celery	Italy	EC		0.75-1.3 0.75-1.2 0.85-1.5 0.63		7 20
Celery	Sweden	EC EG	7.5-10			5
Celery root	Belgium	EC SC	7.5-13	1.2-3.1	1-3	7
Cereal	Austria	EC	6.3-13			21
Cereal	Hungary	EC (grd+air)	7.5-10		1-2	14
Cereals	Algeria	EC	7.5	-	1-3	1
Cereals	Australia	EC UL	5.5-14			7
Cereals	Bulgaria	EC	10			30
Cereals	Ethiopia	EC (grd+air)	7.5-15			0-3
Cereals	Finland	EC	5-10			7
Cereals	France	EC EC EG	4-5 6.3-7.5 6.3-7.5			28 30 30
Cereals	Iraq	UL (grd+air)	7.5-18			3
Cereals	Iraq	UL (grd+air)	7.5-18			3
Cereals	Ireland	EC	4.25-5			-
Cereals	Jordan	EC	1.3-2.5 7.5-19			3 20
Cereals	Libya	EC	7.5			-
Cereals	Netherlands	EC	6.3			28
Cereals	Nigeria	EC	7.5-10			-
Cereals	Norway	EG		1.9-10		14
Cereals	Spain	EC		0.75-1.3		7
Cereals	Sweden	EC	5-13			(last app storage 59-61)
Cereals	Syrian Arab Republic	EC	7.5-13 6.3-7.5			3 7

Crop	Country	Form.	Application			PHI (days)
			Rate (g ai/ha)	Spray concentration (g ai/hl)	No.	
Cereals	Tanzania	EC	7.5			7-14
Cereals	Tunisia	EC		2.5		-
Cereals	Turkey	EC	5-7.5			3
Cereals	Uganda	EC	10	5		1
Cereals	United Arab Emirates	EC	6.3-7.5	1.3		1 -
Cereals (winter)	Spain	EC	7.5-13			7
Cherry	Belgium	EC SC	4.5-12	0.5-1	2-3	7
Cherry	Bulgaria	EC		0.75		7
Cherry	Czech Republic	EC EW		1-1.3	1-3	28?
Cherry	France	EC EG		1.3 1.3		7 7
Cherry	Greece	EC WG		0.88 0.88-1.5		15
Cherry	Italy	EC		0.75-1.9 0.75-1.8 0.85-2.2 0.63-1.3		3 20
Cherry	Netherlands	EC, SC	7.5	0.5	1-2	7
Cherry	Portugal	EC		1.3		7
Cherry, sweet	Romania	EC		0.31-1.9		
Cherry, tart	Poland	EC TB	15			7
Chestnut	France	EC EG		0.75 0.75		14 14
Chestnut	Korea	EC		1	1-6	
Chestnut, horse	Czech Republic	EC EW	6			-?
Chickpea	Australia	EC UL	5.5-14			7
Chickpea	Mexico	EC	10-13			1
Chickpea	Turkey	EC	5-13			3
Chicory	France	EC	7.5			>90
Chicory root	Belgium	EC	7.5-13	1.2-3.2	1-3	7
Chilli pepper	India	EC	10-13			5
Chilli pepper	Indonesia	EC		0.5-1.3		10
Chilli pepper	Malaysia	EC	28		1-10	3
Chilli pepper	Myanmar	EC	3.8-5			3
Chinese cabbage	Belgium	EC SC	7.5-13	0.7-4.2	1-3	7
Chinese cabbage	China	EC	11-19		1-3	5
Chinese cabbage	Korea	EC		0.65	1-3	7
Chinese cabbage	Malaysia	EC	28		1-12	3
Chinese cabbage	Netherlands	EC, SC	7.5		1-3	7, 7G
Chinese mustard	Malaysia	EC	28		1-4	3
Citrus	Algeria	EC	25	-	1-3	1
Citrus	Brazil	EC (grd+air)		0.37-1.3		21
Citrus	China	EC		0.5-1	1-3	28
Citrus	Greece	EC WG		0.88-1.8 0.88-1.8		15 30
Citrus	Italy	EC		1.1-1.5 0.75-1.5 0.85-1.7		3

Crop	Country	Form.	Application			PHI (days)
			Rate (g ai/ha)	Spray concentration (g ai/hl)	No.	
				0.5-0.63		20
Citrus	Jordan	EC	7.5-19	0.75-1.9		20
Citrus	Kenya	EC	13	1.3		1
Citrus	Korea	EC		1	1-6	7
Citrus	Malaysia	EC	14		1-8	3
Citrus	Mauritius	EC		1.3		
Citrus	Morocco	EC	3			
Citrus	Oman	EC		0.75-1.3		0
Citrus	Spain	EC		0.75-1.3		35
Citrus	Syrian Arab Republic	EC		0.75		7
Citrus	Uganda	EC	13	1.3		1
Citrus	United Arab Emirates	EC		6.3-7.5		21
Clover	Norway	EG		1.9-3.8		14
Clover	Poland	EC	7.5			7
Clover pasture	Uruguay	EC	5.6			14
Cocoa	Malaysia	EC	2.2-3.4		1-4	14
Coffee	Brazil	EC (grd+air)	2.5-3.8/1000 holes			15
Coffee	Costa Rica	EC (grd+air)	12			8
Coffee	Dominican Republic	EC	12 5-7.5	1.9-2.5		1
Coffee	El Salvador	EC	5-7.5	1.9-2.5		1
Coffee	Guatemala	EC TB	5-7.5	1.9-2.5		1
Coffee	Honduras	EC	5-7.5	1.9-2.5		1
Coffee	Kenya	EC	6.3	0.63		1
Coffee	Paraguay	EC	2-3			15
Coffee	Tanzania	EC	6.3			7-14
Coffee	Uganda	EC	18/500-600 trees			1
Coffee	Zimbabwe	EC, SC	13		1-2	Nil
Cole crops	Australia	UL EC	11-14	1.1-1.4		2
Cole, fodder	Poland	EC	5-7.5			7
Corn, see also maize						
Corn	China	EC	3.8-7.5			
Corn	Hungary	EC	7.5		1-2	8
Corn	Indonesia	EC	5-10			10
Corn	Norway	EG		1.9-3.8		14
Corn	Philippines	EC		0.93-1.6		1
Corn	Russian Federation	EC	13-18			20
Corn	Syrian Arab Republic	EC	13 6.3-7.5			3 7
Corn	Thailand	EC		1.5		7
Corn	Turkey	EC	13			3
Corn	Ukraine	EC	13-18			20
Corn	United Arab Emirates	EC	6.3-7.5			21
Cotton	Argentina	EC	2.5-3 2.5-7.5			14 14
Cotton	Australia	EC UL	5-19			7
Cotton	Bangladesh	EC	13	2.5		
Cotton	Bolivia	SC	5-7.5	2.5-7.5		7
Cotton	Brazil	EC (grd+air) SC	2.5-10 7.5-13			7

Crop	Country	Form.	Application			PHI (days)
			Rate (g ai/ha)	Spray concentration (g ai/hl)	No.	
Cotton	China	EC	11-19		1-3	14
Cotton	Colombia	EC	13			15
Cotton	Colombia	EC (air) UL (air) SC	18 12-16 18-25			15 - -
Cotton	Costa Rica	EC (grd+air)	12			8
Cotton	Dominican Republic	EC	6.3-12 5-7.5	1.9-2.5		1
Cotton	Ecuador	EC	10-13			15
Cotton	Ethiopia	EC (grd+air)	13-15			0-3
Cotton	Greece	EC WG	8.8–19	0.88-1.9		30 30
Cotton	India	EC	10-13			30
Cotton	Indonesia	EC		1.3-2.5		10
Cotton	Iraq	UL (grd+air)	15-19			3
Cotton	Italy	EC	7.5 8.5 6.3	0.75		15 20
Cotton	Kazakhstan	EC	10-18			20
Cotton	Kenya	EC	10	5		1
Cotton	Mali	EC	9-10			30
Cotton	Mauritania	EC	9			30
Cotton	Mexico	EC	13			1
Cotton	Myanmar	EC	5			3
Cotton	Namibia	EC (grd+air)	6.3-7.5		1-2	28
Cotton	Nigeria	EC	10 9			- 30
Cotton	Paraguay	SC EC EC	10 2.5-10 7.5-10			 28
Cotton	Peru	EC	13-20			1
Cotton	Philippines	EC		1.2-1.6		1
Cotton	Senegal	EC	9			30
Cotton	South Africa	TB (grd+air)	4.5-6	2.5		- (28 gr[5])
Cotton	Spain	EC ULV	 13-18	0.75-1.3		35
Cotton	Syrian Arab Republic	EC	7.5-13			3
Cotton	Tanzania	EC	7.5			7-14
Cotton	Thailand	EC		3-12		7
Cotton	Turkey	EC	19-25			3
Cotton	Uganda	EC	10	5		1
Cotton	USA	EC (grd+air)	15-34		1-10	21
Cotton	Venezuela	EC	8.8-13 13-16			5
Cotton	Zimbabwe	EC, SC, TB (grd+air)	4.1-5.8 3.5-5			nil
Cowpea	Nigeria	EC	6.3-10			-
Cress	Belgium	EC SC	7.5-13	1.2-3.1	1-3	7
Cress, garden	France	EC EC	5 5			7 7
Crops	Nigeria	EC	7.5-13			-
Crops	South Africa	EC (grd+air)	4			28
Crops (except cotton)	Zimbabwe	EC, SC	1.5	3	1	Apply at planting/ germination
Cruciferous	Thailand	EC		1.5-3		7
Crucifers	Namibia	EC		0.5	1-2	3
Cucumber	Belgium	EC SC	7.5-13	0.7-2.1	1-3	3

Crop	Country	Form.	Application			PHI (days)
			Rate (g ai/ha)	Spray concentration (g ai/hl)	No.	
Cucumber	Brazil	EC (grd+air) TB SC		0.75 1 0.75		2
Cucumber	Costa Rica	EC (grd+air)	12			8
Cucumber	Dominican Republic	EC	5-12 5-7.5	 1.9-2.5		1
Cucumber	El Salvador	EC	5-7.5	1.9-2.5		1
Cucumber	Finland	EC		1.3		4
Cucumber	France	EC	7.5 7.5-13			3 3
Cucumber	Greece	EC WG		0.88-1.9 0.88-1.9		3 7
Cucumber	Guatemala	EC TB	5-7.5	1.9-2.5		1
Cucumber	Honduras	EC	5-7.5	1.9-2.5		1
Cucumber	Italy	EC		0.75-1.3 0.75-1.2 0.85-1.5 0.75-1.3 0.63		3 3 20
Cucumber	Korea	EC		1	1-3	3
Cucumber	Malaysia	EC	14		1-8	3
Cucumber	Netherlands	EC, SC (glasshouse)	2.5-25	0.13	1-2	3G
Cucumber	Norway	EG		1.9-3.8		14
Cucumber	Poland	EC	6.3-7.5	1.3		3
Cucumber	Sweden	EC EG	13			
Cucumber	UK	EC, EG (glasshouse)		1.8	-	-
Cucurbits	Spain	EC		0.75-1.3		3
Cucurbits	Syrian Arab Republic	EC	6.3-9.4			7
Cucurbits	United Arab Emirates	EC	6.3-8.8			21
Cumin	Czech Republic	EC	5			-
Currant, black	Finland	EC	7.5-15			21
Currant, black	Netherlands	EC, SC	5-6	0.5	1-2 1-3G	7 7G
Currant, black	Sweden	EC EG	13			
Currant, red	Finland	EC	10-18			21
Currant, red	Netherlands	EC, SC	5-6	0.5	1-2 1-3G	7 7G
Dandelion	France	EC EG	7.5-13 7.5-13			7 7
Dates	United Arab Emirates	EC		2.5		1
Dill	Czech Republic	EC EW	5			-?
Dill	Poland	EC	6.3-7.5			7
Dill	Sweden	EC EG	7.5			7
Egg plant	Argentina	EC EC TB		1 1 1-1.5		3
Egg plant	Bangladesh	EC	13	2.5		
Egg plant	Belgium	EC SC	7.5-13	0.7-2.1	1-3	3
Egg plant	Brazil	EC (grd+air)		0.75-1.3		3
Egg plant	France	EC	7.5			7

Crop	Country	Form.	Application			PHI (days)
			Rate (g ai/ha)	Spray concentration (g ai/hl)	No.	
		EC EG	7.5-13 7.5-13			3” 3
Egg plant	Greece	EC WG		0.88-1.9		3 7
Egg plant	Italy	EC		0.75-1.3 0.75-1.2 0.85-1.5 0.63		3 20
Egg plant	Malaysia	EC	14-28		1-10	3
Egg plant	Netherlands	EC, SC (glasshouse)	2.5-25	0.13	1-2	3G
Egg plant	Philippines	EC		1.56		1
Egg plant	Taiwan	EC	25-38			12
Endive	Belgium	EC SC	7.5-13	1.2-3.1	1-3	7
Endive	France	EC EG	7.5-13 7.5-13			7 7
Endive	Netherlands	EC, SC		1.3		14
Escarole	Spain	EC		0.75-1.3		7
Faba bean	Australia	EC UL	5.5			7
Feed rape	Austria	EC	2.5-7.5			7
Fennel	Belgium	EC SC	7.5-13	1.9-3.1	1-3	7
Fennel	Czech Republic	EC EW	5			-?
Fennel, bulb	Netherlands	EC, SC	7.5		1-2	7
Field crops	Kenya	EC	13	3.8		1
Field crops	Uganda	EC	13	6.3		1
Field crops	United Arab Emirates	EC		1.3		1
Field peas	Australia	EC UL	5.5-14			7
Field peas	Belgium	EC SC	6.3	2.1	1-3	7
Fig	Brazil	EC (grd+air)		1.3		14
Fig	France	EC EG		0.75-1.8 0.75-1.8		14 14
Fig	Greece	EC, WG		0.88-1.5		15
Fig	Spain	EC		0.75-1.3		7
Forage	Ethiopia	EC (grd+air)	7.5-15			0-3
Forage	Iraq	UL (grd+air)	7.5-18			3
Fruit	Jordan	EC	1.3-2.5			3
Fruit	Myanmar	EC	3.8-5			3
Fruit trees	Algeria	EC	7.5	-	1-3	1
Fruit trees	Mauritius	EC		1.3		
Fruit trees	Morocco	EC		0.75-1		
Fruit trees	Oman	EC		0.75-1.3		0
Fruit trees	Tanzania	EC	13			7-14
Fruit trees	Turkey	EC		0.75		3
Fruit trees	Uganda	EC	13	1.3		1
Fruit trees	United Arab Emirates	EC		1.3-2.5		1
Fruits	Ethiopia	EC (grd+air)	7.5-15			0-3
Fruits	Iraq	UL (grd+air)	7.5-18			3
Garlic	Belgium	EC SC	7.5-13	1.2-3.1	1-3	7
Garlic	Brazil	EC (grd+air) SC		0.75 0.75		5
Garlic	Chile	EC	5-10			7
Garlic	Dominican Republic	EC	5-7.5	1.9-2.5		1

Crop	Country	Form.	Application			PHI (days)
			Rate (g ai/ha)	Spray concentration (g ai/hl)	No.	
Garlic	El Salvador	EC	5-7.5	1.9-2.5		1
Garlic	France	EC EG	7.5-13 7.5-13			7 7
Garlic	Guatemala	EC TB	5-7.5	1.9-2.5		1
Garlic	Honduras	EC	5-7.5	1.9-2.5		1
Garlic	Peru	EC	13			1
Garlic	Thailand	EC		1.5-3		7
Garlic	Venezuela	EC	13-16			5
Gherkin	Belgium	EC SC	5	1.2-2.1	1-3	3
Gherkin	France	EC	7.5 13			3 3
Gherkin	Netherlands	EC, SC (glasshouse)	2.5-25	0.13	1-2	3G
Glasshouse crops	Ireland	EC	13			-
Gooseberry	Finland	EC	7.5-18			7
Gooseberry	Netherlands	EC, SC		0.5		7
Gooseberry	Norway	EG		1.9-3.8		14
Grain legumes	Spain	EC		0.75-1.3		7
Grape	Austria	EC		0.75-1.0		35
Grape	Belarus	EC	10-15			30
Grape	Bulgaria	EC		1		7
Grape	Czech rep.	EC (grd+air) EW	10-13		1-2	21?
Grape	France	EC EC EG	7.5 7.5-18 7.5-18			21”cpm 7 7
Grape	Greece	EC, WG		0.88-1.8		10
Grape	Hungary	EC (grd+air)	7.5		1-4	3
Grape	Italy	EC		0.75-1.5 0.85-1.7 0.5-0.75		3 20
Grape	Jordan	EC	1.3-2.5 7.5-19			3 20
Grape	Kazakhstan	EC	10-15			30
Grape	Moldova	EC	10-15			30
Grape	Namibia	EC SC		0.3 0.3-0.63	1-2	28? 42
Grape	Netherlands	EC, SC	2.5-7.5	0.5	1-2	7, 7G
Grape	New Zealand	EC		2.5		Use before start of flowering
Grape	Oman	EC		0.75-1.3		0
Grape	Portugal	EC		0.75-1.3 0.75-1.3 0.75		14 4 14
Grape	Romania	EC	5-50	2.5		
Grape	Russian Federation	EC	10-15			30
Grape	South Africa	TB	5.5-8.5	0.25	1-2	42
Grape	Spain	EC ULV	 7.5-13	0.75-1.3		3 7
Grape	Syrian Arab Republic	EC		0.63-0.75		7
Grape	Taiwan	EC	13		1-3	15
Grape	Tunisia	EC		1.3		-
Grape	Turkey	EC		0.75-1.3		3
Grape	Ukraine	EC	10-15			30
Grape	United Arab	EC		1.3		1

Crop	Country	Form.	Application			PHI (days)
			Rate (g ai/ha)	Spray concentration (g ai/hl)	No.	
	Emirates			6.3-7.5		21
Grape	Uruguay	EC	8.4-17	0.56-0.84		14
Grape	Venezuela	EC	16			5
Grass	Poland	EC	10			7
Greenhouse vegetables	Bulgaria	EC		1.3		7
Guava	Malaysia	EC	14-23		1-6	14
Guava	Taiwan	EC	5			6
Hazelnut	France	EC EG		0.75 0.75		14 14
Hazelnut	Poland	EC	15			7
Hazelnut	Turkey	EC		0.75		3
Hops	Austria	EC		1.3		7
Hops	Belarus	EC	15-25			25
Hops	Belgium	EC EG	13-40	0.8-2.6	2-3	7
Hops	Kazakhstan	EC	15-25			25
Hops	Namibia	EC		0.45	1-2	7
Hops	Poland	EC		1.3		7
Hops	Russian Federation	EC	13			25
Hops	Spain	EC		0.75-1.3		35
Hops	Ukraine	EC	15-25			25
Hops	UK	EC, EG	8.8	2	1-6	-
Horseradish	Sweden	EC EG	7.5-10			5
Indian jujube	Taiwan	EC	23-30			9
Kale	Belgium	EC SC	7.5-13	0.7-4.2	1-3	7
Kale	Brazil	EC (grd+air)		0.75		2
Kale	Canada	EC	10	2.5-3.3		(1gr[6])
Kale	Netherlands	EC, SC	2.5-10	1.3	1-3	7, 7G
Kale	UK	EC, EG	3.8-7.5 7.5		 4	- 3
Kiwifruit	France	EC EG		1.3 1.3		14 14
Kiwifruit	New Zealand	EC		2.5		Use before first visible petals
Kohlrabi	Belgium	EC SC	7.5-13	0.7-4.2	1-3	7
Kohlrabi	Czech Republic	EC EW	5-7.5			7?
Kohlrabi	Netherlands	EC, SC	7.5		1-3	7, 7G
Lavender, broadleaved	Russian Federation	EC	7.5			30
Leaf and stem vegetables	Greece	EC, WG		0.88-1.9		7
Leek	Belgium	EC SC	7.5-13	1.9-3.1	1-3	7
Leek	Czech Republic	EC EW	7.5			10?
Leek	France	EC EG	7.5-13 7.5-13			7 7
Leek	Italy	EC		0.75-1.3 0.75-1.2 0.85-1.5 0.63		7 20
Leek	Netherlands	EC, SC	7.5		1-3	7
Leek	Norway	EG		1.9-3.8		14
Leek	Poland	EC	6.3-7.5			7
Leek	Spain	EC		0.75-1.3		7
Leek	Sweden	EC	7.5-10			7

Crop	Country	Form.	Application			PHI (days)
			Rate (g ai/ha)	Spray concentration (g ai/hl)	No.	
		EG				
Legume (beans, soya beans etc)	Philippines	EC		1.2-1.6		1
Legume vegetables, green (fresh)	Spain	EC		0.75-1.3		3
Legumes	Ethiopia	EC (grd+air)	7.5-15			0-3
Legumes	Iraq	UL (grd+air)	7.5-18			3
Legumes	Romania	EC		1-1.3		
Legumes	Syrian Arab Republic	EC	7.5 7.5-9.4			3 7
Legumes	United Arab Emirates	EC	7.5-9.4			21
Lentil	Australia	EC UL	5.5-14			7
Lentil	Canada	EC	4-5	1.8-4.5	1-3	30 (1gr[7])
Lentil	Canada	EC (air)	4-6	18-54	1-2	30 (1gr)
Lentil	Czech Republic	EC (grd+air) EW	5		1-2	-?
Lentil	France	EC EG	6.3-7.5 6.3-7.5			- -
Lentil	Turkey	EC	5-13			3
Lettuce	Dominican Republic	EC	6.3 5-7.5	3.1 1.9-2.5		1
Lettuce	El Salvador	EC	5-7.5	1.9-2.5		1
Lettuce	France	EC EC EC EG	7.5 7.5-13 13 7.5-13			14 7 3 7
Lettuce	Greece	EG, WG		0.88-1.9		7
Lettuce	Guatemala	EC TB	5-7.5	1.9-2.5		1
Lettuce	Honduras	EC	5-7.5	1.9-2.5		1
Lettuce	Ireland	EC	7.5			1
Lettuce	Italy	EC		0.75-1.3 0.75-1.2 0.75-1.5 0.75-1.3 0.63		3 3 20
Lettuce	Namibia	EC	6.3		1-2	3
Lettuce	Netherlands	EC, SC	2.5-10		1-3	14, 14G
Lettuce	Portugal	EC		1.3 0.75		7 (21 G) 2
Lettuce	Spain	EC		0.75-1.3		7
Lettuce	Sweden	EC EG	7.5-10			7
Lettuce	UK	EC, EG	6.3		1-2	-
Lettuce	Venezuela	EC	8.8-13 13-15.6			5
Lettuce (head)	Belgium	EC SC	7.5-13	1.2-3.1	1-3	7
Lettuce (leaf)	Belgium	EC SC	7.5-13	1.2-3.1	1-3	7
Lime (citron?)	Korea	EC		1	1-5	21
Linseed	Argentina	EC	6.3-7.5 6-7.5			14 14
Linseed	Australia	EC UL	5.5-14			7
Linseed	Belarus	EC	7.5			Not applicable
Linseed	Belgium	EC	6.2	2.1	1-3	7

Crop	Country	Form.	Application			PHI (days)
			Rate (g ai/ha)	Spray concentration (g ai/hl)	No.	
		SC				
Linseed	Canada	EC	4-10	1.8-10	1-3	40 (1gr[2])
Linseed	Canada	EC (air)	4-10	10-68	1-2	40 (1gr)
Linseed	Czech Republic	EC (grd+air) EW	5-7.5			-?
Linseed	France	EC	7.5			30
Linseed	Kazakhstan	EC	7.5			-
Linseed	Netherlands	EC, SC	7.5		1-2	-
Linseed	Russian Federation	EC	7.5			-
Litchi	China	EC		0.5-8.3		
Litchi	Taiwan	EC	25-38			9
Lupin	Australia	EC UL	5.5-14			7
Lupin	Belarus	EC	5-7.5			30
Lupin	Kazakhstan	EC	5			30
Lupin	Namibia	EC (air)	5		1	3
Lupin	Russian Federation	EC	5			30
Lupin	South Africa	TB (air)	3.5-5		1-2	- (3 gr)
Lupin	Ukraine	EC	5-7.5			30
Maize	Argentina	EC	13 2.8-4 4-4.5 5-7.5 4-13			14 30 14 14 14
Maize	Australia	EC UL	14	1.4		7
Maize	Austria	EC	13			28
Maize	Belarus	EC	13-18			20
Maize	Bolivia	SC	7.5-10	3.8		1
Maize	Brazil	EC (grd+air) SC	4-5 2.5-3.8			1
Maize	Bulgaria	EC	25			30
Maize	Canada	EC	13-15	<6.3	1-3	(1gr[6])
Maize	Chile	EC	5-10			7
Maize	Costa Rica	EC (grd+air)	12			8
Maize	Czech Republic	EC (grd+air) EW	10-13		1-2	-?
Maize	Dominican Republic	EC	4-12 5-7.5	1.9-2.5		1
Maize	El Salvador	EC	5-7.5	1.9-2.5		1
Maize	France	EC EC EG	7.5 20 7.5-20			14 14 14
Maize	Greece	EC WG	8.8-15	 0.88-1.5		30 30
Maize	Guatemala	EC TB	5-7.5	1.9-2.5		1
Maize	Honduras	EC	5-7.5	1.9-2.5		1
Maize	Italy	EC		0.75-1.3 0.75-1.2 0.85-1.5 6.3		3 20
Maize	Jordan	EC	7.5-19			20
Maize	Kazakhstan	EC	13-18			20
Maize	Kenya	EC	6.3	3.1		1
Maize	Mexico	EC, TB	5-7.5			1
Maize	Namibia	EC (grd+air)	5-15		1-3	14[8]
Maize	New Zealand	EC	9.9-12			7[9]
Maize	Paraguay	SC EC	2.5-3.8 4			

Crop	Country	Form.	Application			PHI (days)
			Rate (g ai/ha)	Spray concentration (g ai/hl)	No.	
		EC	2.5-3.5			21
Maize	South Africa	TB (grd+air)	5-6	1	1-2	14
Maize	Spain	EC ULV	 13-18	0.75-1.3		3 35
Maize	Uganda	EC	6.3	3.1		1
Maize	Uruguay	EC	5.6-8.4			14
Maize	Venezuela	EC	6.3-10 10-13			5
Maize, fodder	Sweden	EC	10			
Maize, sugar	Sweden	EC	10			
Mango	Bangladesh	EC	13	2.5		
Mango	India	EC		0.92-1.4		1
Mango	Malaysia	EC	14-23		1-6	14
Mango	Namibia	EC		1	1-2	28
Mango	Philippines	EC TB		1.2-1.6 2.5-3.3		1
Mango	Taiwan	EC	6.9-8.3			9
Mango	Thailand	EC		1.5		7
Marrows	Ireland	EC	7.5			1
Melon	Belgium	EC SC	7.5-13	0.7-2.1	1-3	3
Melon	Brazil	EC (grd+air)		0.75		1
Melon	Chile	EC	5-10			7
Melon	Costa Rica	EC (grd+air)	12			8
Melon	Dominican Republic	EC	5-12 5-7.5	 1.9-2.5		1
Melon	El Salvador	EC	5-7.5	1.9-2.5		1
Melon	Guatemala	EC TB	5-7.5	1.9-2.5		1
Melon	Honduras	EC	5-7.5	1.9-2.5		1
Melon	Kazakhstan	EC	6.3-13			-
Melon	Malaysia	EC	14		1-8	3
Melon	Moldova	EC	6.3-13			30
Melon	Netherlands	EC, SC (glasshouse)	2.5-25	0.13	1-2	3G
Melon	Russian Federation	EC	6.3-13			-
Melon	Spain	EC		0.75-1.3		3
Melon	Taiwan	EC	25-43			6
Melon	Ukraine	EC	6.3-13			-
Millet	China	EC	7.5-9.4			
Mushrooms	Austria	EC		0.75/hl/100 m^2		3
Mushrooms	Finland	EC TB		0.75		3
Mushrooms	Italy	EC		0.75-1.2 0.85-1.5		3
Mushrooms	Netherlands	EC, SC	0.75 mg/100 m^2		1-3	2G
Mushrooms	Netherlands	EC, SC	7.5	0.75-1.5	1-3	2G
Mushrooms	Poland	EC		0.75		2
Mushrooms	Spain	EC		0.75-1.3		3
Mustard	Canada	EC SC	5-7.5	5-7.5		14
Mustard	Canada	EC (air) SC	5-7.5	23-68	1	14
Mustard	Czech Republic	EC (grd+air) EW	5-7.5			-?
Mustard	Poland	EC	5-8.8			35
Mustard	UK	EC, EG	6.3-7.5		1-5 (last end flowering)	
Mustard	Taiwan	EC	25-38			6

Crop	Country	Form.	Application			PHI (days)
			Rate (g ai/ha)	Spray concentration (g ai/hl)	No.	
(pickling)						
Nectarine	Chile	EC		0.2-0.65		25
Nectarine	Namibia	EC SC	7.5-22	0.3-0.63	1-2	21
Nectarine	South Africa	TB	5.5-8.5	0.25	1-2	21
Oats	Argentina	EC	3.8 4			7 14
Oats	Belarus	EC	6.3-7.5			20
Oats	Belgium	EC SC	5	2	1-4	7
Oats	Canada	EC	4-10	1.8-10	1-3	31 (1gr[7])
Oats	Canada	EC (air)	4-10	10-68	1-2	31 (1gr)
Oats	Czech Republic	EC (grd+air) EW	5-7.5		1-2	-?
Oats	Netherlands	EC	6.3		1-2	28
Oats	Poland	EC TB	6-7.5 6.3-7.5			21
Oats	Portugal	EC	6.3 7.5-13	 0.75-1.3		21 21
Oats	UK	EC, EG	6.3 5		1[3] 1[4]	-
Oil crops	Ethiopia	EC (grd+air)	7.5-15			0-3
Oil crops	Iraq	UL (grd+air)	7.5-18			3
Oil crops	Norway	EG		2.5-3.8		14
Oilseeds	Sweden	EC	3.8-10			
Olive	Algeria	EC	13	-	1-3	1
Olive	France	EC EG		1.3-1.8 1.3-1.8		7 7
Olive	Greece	EC, WG		1-1.8		15
Olive	Italy	EC		1.05-1.5 1-1.5 0.63		3 20
Olive	Jordan	EC	1.3-2.5 7.5-19			3 20
Olive	Morocco	EC		1		
Olive	Portugal	EC		1.3		7
Olive	Spain	EC	5			7
Olive	Syrian Arab Republic	EC UL	7.5-13	 0.63-0.75		3 20
Olive	Tunisia	EC		1.3		-
Olive	Turkey	EC		0.63-0.75		3
Olive	United Arab Emirates	EC		6.3-7.5		21
Onion	Belgium	EC SC	7.5-13	1.2-3.1	1-3	7
Onion	Brazil	EC (grd+air) TB SC		0.75 0.75 0.5		2
Onion	Canada	EC	10	2-5	1	5
Onion	Chile	EC	5-10			7
Onion	Colombia	TB	10	2.5		15
Onion	Czech Republic	EC EW	7.5			10?
Onion	Dominican Republic	EC	5-7.5	1.9-2.5		1
Onion	El Salvador	EC	5-7.5	1.9-2.5		1
Onion	France	EC EG	7.5-13 7.5-13			7 7
Onion	Guatemala	EC TB	5-7.5	1.9-2.5		1
Onion	Honduras	EC	5-7.5	1.9-2.5		1
Onion	Italy	EC		0.75-1.3		7

Crop	Country	Form.	Application			PHI (days)
			Rate (g ai/ha)	Spray concentration (g ai/hl)	No.	
				0.75-1.2 0.75-1.5 0.63		20
Onion	Namibia	EC	2.5-5	1	1-2	2
Onion	Netherlands	EC, SC	7.5		1-3	7
Onion	New Zealand	EC	9.9			14
Onion	Peru	EC	13			1
Onion	Poland	EC	6.3-7.5			7
Onion	Sweden	EC EG	7.5-10			7
Onion	Venezuela	EC	13-16			5
Orchards	Bulgaria	EC		0.75		7
Orchards	Libya	EC		0.75-1.3		7-14
Palm oil	Indonesia	EC	6.3-7.5			10
Palm, African oil	Thailand	EC		0.75		7
Parsley	Czech Republic	EC EW	5			-?
Parsley	France	EC	5			7
Parsley	Poland	EC EG	7.5			7
Parsley	Sweden	EC EG	7.5			7
Parsnip	Belgium	EC SC	7.5-13	1.2-3.1	1-3	7
Parsnip	Czech Republic	EC EW	5			-?
Parsnip	Sweden	EC EG	7.5-10			5
Pasture	Belarus	EC	7.5-15			20
Pasture	Brazil	EC (grd+air) UL	7.5-10			3
Pasture	Colombia	EC	10-13			15G
Pasture	Kazakhstan	EC	10-13			20
Pasture	Korea	EC		1	1-3	5
Pasture	Namibia	EC	6.3			3G[8]
Pasture	Norway	EG		1.9-3.8		14
Pasture	Russian Federation	EC	7.5-13			20
Pasture (improved)	Argentina	EC	13 3-3.2 13			14 grazing 14 14
Pasture (rangeland, roadside)	Canada	EC SC	5-7.5	2.5-7.5	1-3	(1gr[10])
Pasture (rangeland, roadside)	Canada	EC (air) SC	7.5	34-68	1	(1gr)
Peach	Argentina	EC		0.38-0.5 0.4-0.5		7 7
Peach	Brazil	EC (grd+air) SC		0.75-1 1		5
Peach	Bulgaria	EC		1		7
Peach	Canada	EC	10	0.34	1	7 or 1[11]
Peach	Chile	EC		0.2-0.65		25
Peach	France	EC EG		0.75-1.8 0.75-1.8		7 7
Peach	Greece	EC, WG		0.88-2.25		15
Peach	Italy	EC		0.75-1.9 0.75-1.8 0.85-2.2 0.75-1.8		3 3

Crop	Country	Form.	Application			PHI (days)
			Rate (g ai/ha)	Spray concentration (g ai/hl)	No.	
				0.63-1.3		20
Peach	Kazakhstan	EC	13			20
Peach	Kenya	EC	13	1.3		1
Peach	Moldova	EC	13			20
Peach	Namibia	EC SC	7.5-22	0.3-0.63	1-2	21
Peach	Portugal	EC		1.3 1.3		21 7
Peach	Russian Federation	EC	13			20
Peach	South Africa	TB	5.5-8.5	0.25	1-2	21
Peach	Ukraine	EC	13			20
Peach	Uruguay	EC	8.4-17	0.56-0.84		14
Peanut	Argentina	EC	6		-	14
Peanut	Brazil	EC (grd+air)	5			3
Peanut	China	EC	7.5-11			
Peanut	Dominican Republic	EC	5-7.5	1.9-2.5		1
Peanut	El Salvador	EC	5-7.5	1.9-2.5		1
Peanut	Guatemala	EC	5-7.5	1.9-2.5		1
Peanut	Honduras	EC	5-7.5	1.9-2.5		1
Peanut	India	EC	13			3
Peanut	Namibia	EC (grd+air)	6.3		1-2	7
Peanut	South Africa	TB (grd+air)	4.5-5		1-2	- (7 G)
Peanut	Venezuela	EC	8.8-13			5
Pear	Argentina	EC		0.38-0.5 0.4-0.5		7 7
Pear	Belarus	EC	15			30
Pear	Belgium	EC EG	3-12	0.7-1	2-5	7
Pear	Bulgaria	EC		0.75		7
Pear	Canada	EC	10-18	0.33-0.59	1-3	7
Pear	Chile	EC		0.2-0.65		25
Pear	China	EC		0.5-1		
Pear	France	EC EG		0.75-1.8 0.75-1.8		7 7
Pear	Greece	EC, WG		0.88-2.25		15
Pear	Hungary	EC	7.5		1-3	3
Pear	Italy	EC		0.75-1.9 0.75-1.8 0.63-1.3		3 20
Pear	Jordan	EC	7.5-19			20
Pear	Kazakhstan	EC	15			30
Pear	Kenya	EC	13	1.3		1
Pear	Korea	EC		1	1-7	7
Pear	Moldova	EC	15			30
Pear	Namibia	EC SC	6.3-11 7.5-22	0.25-0.63 0.3-0.63	1-2	7 14
Pear	Netherlands	EC, SC	5-6	0.4-0.6	1-3	7
Pear	Portugal	EC		1.3 0.75-1.8 0.75		21 7 14
Pear	Romania	EC		0.63		
Pear	Russian Federation	EC	15			30
Pear	South Africa	TB	5.5-8.5	0.25	1-2	14
Pear	Sweden	EC EG	13-15	0.63-0.75		
Pear	Tunisia	EC		1.9		-
Pear	Turkey	EC		1.3		3
Pear	Ukraine	EC	15			30

Crop	Country	Form.	Application			PHI (days)
			Rate (g ai/ha)	Spray concentration (g ai/hl)	No.	
Pear	UK	EC, EG	8.8	1.3	1-3	
Pear	Uruguay	EC	8.4-17	0.56-0.84		3
Peas	Bulgaria	EC	5			30
Peas	Ireland	EC	7.5			1
Peas	Argentina	EC	7.5 7.5		-	14 3
Peas	Belarus	EC	5			30
Peas	Chile	EC	5-10			7
Peas	Czech Republic	EC (grd+air) EW	5			7 [12]
Peas	Finland	EC TB	5-10			7
Peas	France	EC EC EC EG	6.3 6.3-13 13 6.3-13			7 7 3 7
Peas	Greece	EG WG		0.88-1.5 0.88-1.5		3 7
Peas	Indonesia	EC	6.3-13			10
Peas	Italy	EC		0.75-1.3 0.75-1.2 0.85-1.5 0.75-1.3 0.63		3 3 20
Peas	Kazakhstan	EC	5			30
Peas	Moldova	EC	5			30
Peas	Namibia	EC (grd+air)	6.3		1-2	3
Peas	Netherlands	EC, SC	7.5		1-2	7
Peas	Norway	EG		1.9-3.8		14
Peas	Peru	TB		5		1
Peas	Poland	EC	6.3-7.5			7
Peas	Portugal	EC		0.75-1		2
Peas	Russian Federation	EC	5			30
Peas	South Africa	TB (grd+air)	4.5-5			3
Peas	Ukraine	EC	5			30
Peas	UK	EC, EG	6.3-7.5 6.3-7.5		1-2	- 3
Peas (green)	Belgium	EC SC	6.3	2.1	1-3	7
Peas, protein	France	EC EG	6.3-13 6.3-13			7 7
Pepper	Argentina	EC EC TB		1.5 1.5 1-1.5		3
Pepper	Brazil	EC (grd+air)		0.75-1.3		2
Pepper	Bulgaria	EC	13			7
Pepper	Canada	EC	13-15	5-7.5	1-3	3
Pepper	France	EC EC EG	7.5 7.5-13 7.5-13			7 3 3
Pepper	Indonesia	EC		0.25-0.5		10
Pepper	Italy	EC		0.75-1.3 0.75-1.2 0.85-1.5 0.75-1.3 0.63		3 3 20
Pepper	Korea	EC		1	1-3	3
Pepper	Namibia	EC	6.3		1-2	7
Pepper	Netherlands	EC, SC (glasshouse)	2.5-25	0.13	1-2	3G
Pepper	Poland	EC		1.3		3

Crop	Country	Form.	Application			PHI (days)
			Rate (g ai/ha)	Spray concentration (g ai/hl)	No.	
Pepper	South Africa	TB	4.5-5		1-2	7
Pepper	UK	EC, EG (glasshouse)		1.8	-	-
Pepper	Venezuela	EC	8.8-13			5
Peppermint	Belarus	EC	5			25
Peppermint	Russian Federation	EC	5			25
Persimmon	Korea	EC		1	1-5	3
Pineapple	Brazil	EC (grd+air) SC	5 5			14
Pistachio	Syrian Arab Republic	EC		0.63-0.75		7
Pistachio	Turkey	EC		7.3		3
Plum	Belgium	EC SC	4.5-12	0.5-1	2-3	7
Plum	Brazil	EC (grd+air)		1.3		2
Plum	Bulgaria	EC		1-1.3		7
Plum	France	EC EG		0.75-1.8 0.75-1.8		7 7
Plum	Greece	EC, WG		0.88-2		15
Plum	Italy	EC		0.75-1.9 0.75-1.8 0.85-2.2 0.75-1.8 0.63-1.3		3 3 20
Plum	Kenya	EC	13	1.3		1
Plum	Namibia	EC SC	7.5-22	0.3-0.63	1-2	21
Plum	Netherlands	EC, SC	7.5	0.5	1-2	7
Plum	Romania	EC		0.31-1.9		
Plum	South Africa	TB	5.5-8.5	0.25	1-2	21
Plum	Sweden	EC EG	13-15	0.63-0.75		
Plum	UK	EC, EG	13-20	0.63-2	2-3	
Pome fruit	Bulgaria	EC		1		7
Pome fruit	Czech Republic	EC EW		0.5		28?
Pome fruit	New Zealand	EC		2.5		non-bearing plants
Pome fruit	Spain	EC		0.75-1.3		7
Pome fruit	Syrian Arab Republic	EC	11	0.75		7
Poppy seed	Netherlands	EC, SC	7.5		1-2	7
Potato	Argentina	EC	7.5 7.5 1	1.3		3
Potato	Austria	EC	7.5-13	2-3		7
Potato	Belarus	EC	2.5-6.3			20
Potato	Belarus	EC	0.05 g/m^2			20
Potato	Belgium	EG	7.5	2.5	1-3	7
Potato	Bolivia	SC	7.5-10	5-6.3		1
Potato	Brazil	EC (grd+air) TB SC	10	 1 1		1
Potato	Bulgaria	EC	5-7.5			7
Potato	Canada	EC	5-13	1-4.2	1-3	3 or 13
Potato	Canada	EC (air)	5-7.5	23-68	1-2	3 or 13
Potato	Chile	EC	5-10			7
Potato	Colombia	EC TB EW	10-11 10 2.5	 2.5 1.3		25 15 25

Crop	Country	Form.	Application			PHI (days)
			Rate (g ai/ha)	Spray concentration (g ai/hl)	No.	
Potato	Czech Republic	EC (grd+air) EW	5			14?
Potato	Dominican Republic	EC	5-6.3 5-7.5	1.9-2.5		1
Potato	Ecuador	EC	7.5-10			15
Potato	El Salvador	EC	5-7.5	1.9-2.5		1
Potato	Finland	EC TB	5			7
Potato	France	EC EC EC EG	6.3 7.5 13 7.5			21 7 3 7
Potato	Greece	EC, WG		0.88-1.5		15
Potato	Guatemala	EC TB	5-7.5	1.9-2.5		1
Potato	Honduras	EC	5-7.5	1.9-2.5		1
Potato	Indonesia	EC		1.3-2.5		10
Potato	Italy	EC		0.75-1.3 0.75-1.2 0.84-1.5 0.63		3 20
Potato	Jordan	EC	1.3-2.5			3
Potato	Kazakhstan	EC	2.5-5			20
Potato	Korea	EC		1	1-2	2
Potato	Mauritius	EC	2.1-11			
Potato	Mexico	EC	13			1
Potato	Moldova	EC	2.5-7.2			20
Potato	Morocco	EC	7.5			
Potato	Namibia	EC	4.5-7.5		1-2	2
Potato	Netherlands	EC, SC	5-7.5		1-2	7
Potato	New Zealand	EC	12			14
Potato	Norway	EG		1.9-3.8		14
Potato	Paraguay	EC	3.5-10			15
Potato	Peru	EC TB	13-20	 5-7.5		1
Potato	Poland	EC TB	5-7.5			7
Potato	Portugal	EC		1.3 0.75 0.75		21 7 14
Potato	Romania	EC	7			
Potato	Russian Federation	EC	3.8-7.5			20
Potato	South Africa	TB	6-7.5		1-2	8
Potato	Spain	EC		0.75-1.3		3
Potato	Sweden	EG	7.5-15			
Potato	Syrian Arab Republic	DP	6.3-7.5			7
Potato	Tunisia	EC		2.5		-
Potato	Turkey	EC	7.5			3
Potato	Ukraine	EC	2.55			20
Potato	UK	EC	6.3 7.5		4 4	3 3
Potato	Uruguay	EC		1.4-2.2		14
Potato	Venezuela	EC	8.8-13 16			5
Potato (seed)	Netherlands	EC, SC	5-10		1-2	7
Pulses	Myanmar	EC	3.8-5			3
Pulses (beans)	Belgium	EC SC	7.5-13	2.5-4.2	1-3	7
Pulses (peas)	Belgium	EC SC	6.2	2.1	1-3	7

Crop	Country	Form.	Application			PHI (days)
			Rate (g ai/ha)	Spray concentration (g ai/hl)	No.	
Pumpkin	Belgium	EC SC	7.5-13	0.7-2.1	1-3	3
Pumpkin	El Salvador	EC	5-7.5	1.9-2.5		1
Pumpkin	Guatemala	EC	5-7.5	1.9-2.5		1
Pumpkin	Honduras	EC	5-7.5	1.9-2.5		1
Pumpkin (winter squash)	New Zealand	EC	9.9			Use before start of flowering
Quince	Uruguay	EC	8.4-17	0.56-0.84		14
Radish	Belgium	EC SC	5-13	1.2-3.1	1-3	7
Radish	Czech Republic	EC EW	5-7.5			7?
Radish	France	EC EG	5 5			7 7
Radish	Netherlands	EC, SC	7.5		1-5	7 7G
Radish	Norway	EG		1.9-3.8		14
Rape	Australia	EC UL	5.5-14			7
Rape	Austria	EC	2.5-7.5			56
Rape	Belarus	EC	7.5			20
Rape	Belgium	EC EG	5-6.2	1.7	1-5	7
Rape	Canada	EC SC	5-7.5	5-7.5		14
Rape	Canada	EC (air) SC	5-7.5	23-68	1	14
Rape	China	EC	3.8-7.5			
Rape	Czech Republic	EC (grd+air) EW	5-7.5			-?
Rape	Finland	EC	2.5-7.5			7
Rape	France	EC EC EG	6.3 5-6.3 5-6.3			28 30 30
Rape	Hungary	EC (grd+air)	7.5		1-3	8
Rape	Italy	EC	7.5-12 8.5-15	0.75-1.3		30
Rape	Kazakhstan	EC	7.5			20
Rape	Netherlands	EC, SC	5-7.5		1-2	-
Rape	Poland	EC	5-8.8			35
Rape	Russian Federation	EC	7.5			20
Rape	Spain	EC ULV	13-18	0.75-1.3		35
Rape	Ukraine	EC	7.5 8.8			20 30
Rape	UK	EC, EG	6.3-7.5 6.3		1-5 (last end flowering)	-
Rape, forage	Netherlands	EC, SC	7.5		1-2	-
Raspberry	Finland	EC TB	10-15			7
Raspberry	Netherlands	EC, SC	5-6	0.5	1-2 1-3 G	7 7G
Raspberry	Norway	EG		1.9-3.8		14
Raspberry	Sweden	EC EG	15			
Raspberry	UK	EG, EG	15		1-2	
Redbeet	Belgium	EC SC	7.5-13	1.2-3.1	1-3	7
Rice	Brazil	EC (grd+air) SC	5 2-2.5			37

Crop	Country	Form.	Application			PHI (days)
			Rate (g ai/ha)	Spray concentration (g ai/hl)	No.	
Rice	Colombia	EC	7.5-10			20
Rice	Costa Rica	EC (grd+air)	12			8
Rice	Dominican Republic	EC	3-12 5-7.5	1.9-2.5		1
Rice	Ecuador	EC	5-10			15
Rice	El Salvador	EC	5-7.5	1.9-2.5		1
Rice	Guatemala	EC TB	5-7.5	1.9-2.5		1
Rice	Honduras	EC	5-7.5	1.9-2.5		1
Rice	Philippines	EC TB SC		1.3 3.1 1.3		1
Rice	Taiwan	EC	6.9-8.3			9-15
Rice	Venezuela	EC	6.3-10 10-13			10
Rice	Vietnam	EC	5-10			3
Rosella	Australia	EC UL		1.4		1
Rutabaga fodder	Poland	EC	5-7.5			7
Rye	Argentina	EC	3.8 4			7 14
Rye	Belarus	EC	6.3-7.5			20
Rye	Belgium	EC SC	5	2	1-4	7
Rye	Netherlands	EC	6.3		1-2	28
Rye	Poland	EC	6-10 6.3-10			21
Rye	Portugal	EC	7.5-13	0.75-1.3		21
Safflower	Australia	EC UL	5.5-14			7
Salads	Italy	EC		0.75-1.3 0.75-1.2		3
Salsify	Belgium	EC SC	7.5-13	1.2-3.1	1-3	7
Seed crops	Ireland	EC	7.5			1
Sesame	Dominican Republic	EC	5-7.5	1.9-2.5		1
Sesame	El Salvador	EC	5-7.5	1.9-2.5		1
Sesame	Guatemala	EC TB	5-7.5	1.9-2.5		1
Sesame	Honduras	EC	5-7.5	1.9-2.5		1
Sesame	Korea	EC		1	1	7
Shallots	France	EC EG	7.5-13 7.5-13			7 7
Shallots	Indonesia	EC		1.3-2.5		10
Shallots	Netherlands	EC, SC	7.5			7
Shallots	Thailand	EC		1.5-3		7
Solanaceous	Spain	EC		0.75-1.3		3
Sorghum	Argentina	EC	5-7.5 5-7.5			14 14
Sorghum	Australia	EC UL	5.5-14			7
Sorghum	Brazil	EC (grd+air) UL	5			6
Sorghum	Costa Rica	EC (grd+air)	12			8
Sorghum	Dominican Republic	EC	4-12 5-7.5	1.9-2.5		1
Sorghum	El Salvador	EC	5-7.5	1.9-2.5		1
Sorghum	France	EC EG	20 20			14 14
Sorghum	Guatemala	EC	5-7.5	1.9-2.5		1

Crop	Country	Form.	Application			PHI (days)
			Rate (g ai/ha)	Spray concentration (g ai/hl)	No.	
		TB				
Sorghum	Honduras	EC	5-7.5	1.9-2.5		1
Sorghum	Mexico	EC, TB	5-6.3			1
Sorghum	Namibia	EC (grd+air)	6.3		1-2	28[8]
Sorghum	Paraguay	EC	2.5-5			
Sorghum	South Africa	TB (grd+air)	5	2.5	1-2	28
Sorghum	Uruguay	EC	5.6-8.4			14
Sorghum	Venezuela	EC	6.3 8.8-13			5
Soya bean	Argentina	EC	4-10 2.8-4 1.6-4 2.5-10			14 45 14 14
Soya bean	Australia	EC UL	14			7
Soya bean	Brazil	EC (grd+air) SC	5-7.5 7.5			14
Soya bean	China	EC	6-9		1-2	7
Soya bean	Colombia	EC	7.5			20
Soya bean	Czech Republic	EC (grd+air) EW	5			-?
Soya bean	Dominican Republic	EC	5-7.5	1.9-2.5		1
Soya bean	Ecuador	EC	5-7.5			15
Soya bean	El Salvador	EC	5-7.5	1.9-2.5		1
Soya bean	Guatemala	EC TB	5-7.5	1.9-2.5		1
Soya bean	Honduras	EC	5-7.5	1.9-2.5		1
Soya bean	Indonesia	EC		1.3-2.5		10
Soya bean	Italy	EC	7.5-12 8.5-15	0.75-1.3		15
Soya bean	Mexico	EC	10-13			1
Soya bean	Paraguay	EC	4-7.5 2-6			30
Soya bean	Peru	EC	13-20			1
Soya bean	Uruguay	EC	11			14
Soya bean	Zimbabwe	EC, SC	10	20		3
Spinach	Belgium	EC SC	7.5-13	1.2-3.1	1-3	7
Spinach	France	EC EC EG	7.5 7.5 7.5			15 3 3
Spinach	Italy	EC		0.75-1.3 0.75-1.2 0.75-1.5 0.75-1.3 0.63		3 3 20
Spinach	Sweden	EC EG	7.5			5
Spinach and similar	Spain	EC		0.75-1.3		7
Stone fruit	Czech Republic	EC EW		0.5		28
Stone fruit	Hungary	EC	7.5		1-4	3
Stone fruit	New Zealand	EC		2.5		non-bearing plants
Stone fruit	Spain	EC		0.75-1.3		7
Strawberry	Canada	EC	10	0.34-2.3	1-2	14
Strawberry	Czech Republic	EC EW	7.5	1.3	1	before blossom
Strawberry	Finland	EC TB	6.3-13			7

Crop	Country	Form.	Application			PHI (days)
			Rate (g ai/ha)	Spray concentration (g ai/hl)	No.	
Strawberry	France	EC EG	13 13			3 3
Strawberry	Greece	EC WG		1.5 1.5		3 7
Strawberry	Italy	EC		0.75-1.3 0.75-1.2 0.75-1.3		3 3
Strawberry	Netherlands	EC, SC	1.5-3 3-7	0.5 0.5	1-2 1-3	4 4G
Strawberry	Norway	EG		1.9-3.8		14
Strawberry	Poland	EC	15-20			7
Strawberry	Portugal	EC		0.75		2
Strawberry	Sweden	EC EG	13			
Sugar apple	Taiwan	EC	25-38			3
Sugarcane	Dominican Republic	EC	5-7.5	1.9-2.5		1
Sugarcane	El Salvador	EC	5-7.5	1.9-2.5		1
Sugarcane	Guatemala	EC TB	5-7.5	1.9-2.5		1
Sugarcane	Honduras	EC	5-7.5	1.9-2.5		1
Sugarcane	Thailand	EC		0.75		7
Sunflower	Argentina	EC	3-7.5 2.8-3.2 2.4			14 25 14
Sunflower	Australia	EC UL	14			7
Sunflower	Belarus	EC	6.3			20
Sunflower	Canada	EC	5	2.5-5	1	70
Sunflower	Canada	EC (air)	5	23-45	1	70
Sunflower	France	EC	7.5			60
Sunflower	Hungary	EC (grd+air)	5-38		1-4	8
Sunflower	Moldova	EC	6.3			20
Sunflower	Spain	EC ULV	 13-18	0.75-1.3		35
Sunflower	Turkey	EC	6.3			3
Sunflower	Uruguay	EC	3.4-5.6			14
Swede	Finland	EC TB	5-7.5			7
Swede	Netherlands	EC, SC	7.5		1-5	7
Swede	UK	EC, EG	3.8-7.5 7.5		 4	- 3
Sweet corn	Argentina	EC		1 1		7 7
Sweet corn	Australia	EC UL	14	1.4		5
Sweet corn	Belgium	EC SC	7.5-13	1.2-3.1	1-3	3
Sweet corn	Canada	EC	13-15	5.2-6.3	1-2	5 (1G [14])
Sweet corn	Canada	EC (air)	13-15	57-136	1	5 (1G)
Sweet corn	France	EC EG	20 20			7 7
Sweet corn	Hungary	EC (grd+air)	7.5		1	2
Sweet corn	Namibia	EC (air)	6.3		1-2	
Sweet corn	New Zealand	EC	9.9-12			7[9]
Sweet corn	South Africa	TB (air)	4.5-5		1-2	14
Sweet potato	Namibia	EC		1.3	1-2	2
Swiss chard	Argentina	EC EC TB		0.75 0.7 1-1.5		7
Swiss chard	Belgium	EC SC	7.5-13	1.2-3.1	1-3	7

Crop	Country	Form.	Application			PHI (days)
			Rate (g ai/ha)	Spray concentration (g ai/hl)	No.	
Swiss chard	Uruguay	EC	5.6-8.4	0.56-0.84		14
Tamarillo	New Zealand	EC		2 pre-flower 0.6-1.2 post-flower		7
Tea	Bangladesh	EC	50	10		
Tea	China	EC	3.8-7.5		1	5
Tea	India	EC	2.5-10			3
Tea	Indonesia	EC		1.3-2.5		10
Tea	Myanmar	EC	3.8-5			3
Tea	Russian Federation	EC	13			-
Tea	Taiwan	EC	8.8 6.9			10 15
Tomato	Argentina	EC EC TB		1.3-1.5 1.2-1.5 1-1.5		3
Tomato	Australia	EC	8.3-14	0.83-1.4		3
Tomato	Belarus	EC	3.8-13			30
Tomato	Belgium	EC SC	7.5-13	0.7-2.1	1-3	3
Tomato	Brazil	EC (grd+air) TB		0.75-1.3		3
Tomato	Canada	EC	5-7.5	1-3.8	1-3	3
Tomato	Chile	EC	5-10			5
Tomato	Costa Rica	EC (grd+air)	12			8
Tomato	Czech Republic	EC (grd+air) EW	5			14?
Tomato	Dominican Republic	EC	5-6.3 5-7.5	 1.9-2.5		1
Tomato	El Salvador	EC	5-7.5	1.9-2.5		1
Tomato	France	EC EC EG	7.5 5-13 5-13			7 3 3
Tomato	Greece	EC WG		0.88-1.9 0.88-1.9		3 7,
Tomato	Guatemala	EC TB	5-7.5	1.9-2.5		1
Tomato	Honduras	EC	5-7.5	1.9-2.5		1
Tomato	Indonesia	EC		0.63-1.3		10
Tomato	Italy	EC		0.75-1.3 0.75-1.2 0.85-1.5 0.75-1.3 0.63		3 3 20
Tomato	Kazakhstan	EC	3.8-13			30
Tomato	Malaysia	EC	28		1-10	3
Tomato	Mauritius	EC	2.1-11			
Tomato	Mexico	EC	13			1
Tomato	Moldova	EC	3.8			30
Tomato	Namibia	EC		0.31	1-2	2
Tomato	Netherlands	EC, SC (glasshouse)	2.5-25	0.13	1-2	3G
Tomato	New Zealand	EC	3-9.9	0.74-0.99		3
Tomato	Paraguay	EC EC	 7.5-10	1-1.5		2 21
Tomato	Peru	EC	13			1
Tomato	Philippines	EC		1.2-1.6		1
Tomato	Poland	EC	5-8.8	1.3		3
Tomato	Portugal	EC		0.75-1.3 0.75-1.1		2 7
Tomato	Russian Federation	EC	6.3-10			30

Crop	Country	Form.	Application			PHI (days)
			Rate (g ai/ha)	Spray concentration (g ai/hl)	No.	
Tomato	Thailand	EC		3		7
Tomato	UK	EC, EG (glass-house)		1.8		
Tomato	Ukraine	EC	3.8-13			30
Tomato	Uruguay	EC	5.6-8.4	0.56-0.84		1
Tomato	Venezuela	EC	8.8-13 16			5
Tomato	Zimbabwe	EC, SC		0.5	1-2	3
Triticale	Belarus	EC	6.3-7.5			20
Triticale	Netherlands	EC	6.3		1-2	28
Triticale	Portugal	EC	7.5-13	0.75-1.3		21
Turnip	Austria	EC	13			ns
Turnip	Belgium	EC SC	7.5-13	1.2-3.1	1-3	7
Turnip	Finland	EC, TB	5-7.5			7
Turnip	Netherlands	EC, SC	7.5		1-5	7
Turnip	Norway	EG		1.9-3.8		14
Turnip	UK	EC, EG	3.8-7.5 7.5		4	- 3
Turnip-rooted parsley	Sweden	EC EG	7.5-10			5
Vegetables	Algeria	EC	5-7.5	-	1-3	1
Vegetables	Austria	EC	7.5-18	0.75-2		7
Vegetables	Ecuador	EC	7.5-10			15
Vegetables	Ethiopia	EC (grd+air)	7.5-15			0-3
Vegetables	Greece	EC		0.88-1.9		7
Vegetables	Hungary	EC	7.5		1-2	3-5
Vegetables	Iraq	UL (grd+air)	7.5-18			3
Vegetables	Jordan	EC	1.3-25			3
Vegetables	Kenya	EC	7.5-13	3.8-6.3		1
Vegetables	Libya	EC	13			3-7
Vegetables	Mauritius	EC	2.1-11			
Vegetables	Morocco	EC		1		
Vegetables	Myanmar	EC	3.8-5			3
Vegetables	Oman	EC		0.75-1.3		0
Vegetables	Syrian Arab Republic	EC		0.63-0.75		7
Vegetables	Taiwan	EC	25			6
Vegetables	Tanzania	EC	7.5			7-14
Vegetables	Tunisia	EC		1.9-2.5		-
Vegetables	Turkey	EC	10-25			3
Vegetables	Uganda	EC	6.3-13	0.63-6.3		1
Vegetables	United Arab Emirates	EC	 6.3-8.8	1.3-2.5		1 21
Vegetables	Vietnam	EC	5-10			3
Vetch	Australia	EC UL	14			7
Vetch	Poland	EC	7.5			7
Walnut	France	EC EG		0.75 0.75-1.3		14 14
Walnut	Poland	EC	15			7
Ware crops	Ireland	EC	7.5			1
Watermelon	Brazil	EC (grd+air)		0.75		2
Watermelon	Chile	EC	5-10			7
Watermelon	Costa Rica	EC (grd+air)	12			8
Watermelon	Dominican Republic	EC	5-12 5-7.5	 1.9-2.5		1
Watermelon	El Salvador	EC	5-7.5	1.9-2.5		1
Watermelon	Guatemala	EC	5-7.5	1.9-2.5		1
Watermelon	Honduras	EC	5-7.5	1.9-2.5		1

Crop	Country	Form.	Application			PHI (days)
			Rate (g ai/ha)	Spray concentration (g ai/hl)	No.	
Watermelon	Indonesia	EC		0.63-1.3		10
Watermelon	Kazakhstan	EC	6.3-13			-
Watermelon	Malaysia	EC	14		1-8	3
Watermelon	Moldova	EC	6.3-13			30
Watermelon	Russian Federation	EC	6.3-13			-
Watermelon	Taiwan	EC	13-15			20
Wax apple	Taiwan	EC	7.5-25			6
Wheat	Argentina	EC	3.8 4			7 14
Wheat	Belarus	EC	6.3-7.5			20
Wheat	Belgium	EC SC	5	2	1-4	7
Wheat	Brazil	EC (grd+air)	5			14
Wheat	Bulgaria	EC	7.5			30
Wheat	Canada	EC	4-10	1.8-10	1-3	40 (1G) [2]
Wheat	Canada	EC (air)	4-10	10-68	1-2	40 (1G)
Wheat	China	EC	3.8-5.63		1-3	15
Wheat	Dominican Republic	EC	5-7.5	1.9-2.5		1
Wheat	El Salvador	EC	5-7.5	1.9-2.5		1
Wheat	Greece	EC WG	8.8-15	 0.88-1.5		30 30
Wheat	Guatemala	EC TB	5-7.5	1.9-2.5		1
Wheat	Honduras	EC	5-7.5	1.9-2.5		1
Wheat	Italy	EC	7.5-13 7.5-12 8.5-15 7.5-13 6.3	0.75-1.3 0.75-1.2 0.85-1.5		3 7 20
Wheat	Kenya	EC	10	2.5		1
Wheat	Moldova	EC	6.3			20
Wheat	Namibia	EC (air)	6.3		1-2	21 [8]
Wheat	Netherlands	EC	6.3		1-2	28
Wheat	Oman	EC		0.93-1.3		0
Wheat	Poland	EC	6-10 6.3-10			21
Wheat	Portugal	EC	6.3 7.5-13	 0.75-1.3		21 21
Wheat	Romania	EC	7.5			
Wheat	Russian Federation	EC	6.3			20
Wheat	South Africa	TB	3.5-4		1-2	21
Wheat	UK	EC, EG	5-6.3 5		1-4 [3] 1 [4]	 pirim
Wheat	Uruguay	EC	3.3-5.6			14
Whitloof	Belgium	EC SC	7.5-13	1.2-3.1	1-3	7
Zapallo	Chile	EC	5-10			7
Zucchini	Belgium	EC SC	7.5-13	0.7-2.1	1-3	3
Zucchini	France	EC	7.5 7.5-13			7 3
Zucchini	Ireland	EC	7.5			1
Zucchini	Netherlands	EC, SC (glass-house)	2.5-25	0.13	1-2	3G

G: glasshouse
Gr: grazing

ns: not stated
[1] Do not feed harvested forage within 90 days of harvest
[2] Do not allow beef cattle to graze treated fields within 1 day of application, nor dairy cattle to graze treated fields
Warning: dairy cattle must not be fed or grazed on deltamethrin treated crops. Foraging is only permitted for rangeland beef cattle
[3] last application at growth stage 83
[4] last application before grain watery ripe (growth stage 71)
[5] 28 days between last application and grazing
[6] Do not allow beef cattle to graze treated fields within 1 day of application. Do not allow dairy cattle to graze treated fields, nor feed them treated silage or stubble
[7] Do not allow beef cattle to graze treated fields within 1 day of application, nor dairy cattle to graze treated fields
[8] 3 days between last application and grazing
[9] do not graze or feed stubble to animals within 14 days
[10] not allow rangeland beef cattle to graze treated fields within 1 day of application. Warning: dairy cattle must not be fed or grazed on deltamethrin treated crops. Foraging is only permitted for rangeland beef cattle
[11] Decis 25 EC 7 days, Decis 5 EC 1 day
[12] Treated peas must not be fed
[13] Decis 25 EC 7 days, Decis 5 EC 1 day – appropriate PHIs
[14] Do not allow beef or dairy cattle to graze treated field within 1 day of application

Table 47. Registered post-harvest uses of deltamethrin.

Commodity	Country	Form.	Application	Rate (g ai/tonne)	Spray concentration (g ai/hl)
Stored grain	China	EC	P_O	0.5-1 for 9-12 months protection	
Stored cereal grain	Australia	EC, SC		1 for up to 9 m protection	
Stored grain	Chile	EC	Grain	0.065 g/t(3m) 0.13 g/t (6m)	
Stored grain	Chile	EC	Sacks and surfaces (machinery, storage installations, transports)		8.5-23 applied to 100 m^2 (3-4 m)
Stored maize	Columbia	EC		10 g/t mixed in to top 25 cm layer	
Stored grain	France	PP/DP		1 g/quintal: 100 kg of grain: 10 g/t mixed into the top 20 cm layer of grain	
Stored grain	France	EC		0.25 g/t for 6-9 m protection 0.5 g/t for 12 months protection	
Small grain	Italy	EC DP SU	Po	0.25-0.5g ai/tonne	
Wheat, rice, grains and seeds in stacks	India	WP	Bag spray	0.03 g ai/m^2 of sack stacks	
Stored product	Indonesia	SC	Bag spray	0.004-0.015 g ai/m^2 of sack stacks	
Stored cereals	Spain	DP ULV		0.5-1 0.24-0.48	
Stored grain legumes	Spain	DP ULV		0.5-1 0.24-0.48	
Stored grain	Venezuela	ULV		0.5	

RESIDUES RESULTING FROM SUPERVISED TRIALS

The results for the residue trials are shown in Tables 48-104 and are reviewed in order of the Codex Alimentarius Classification of Foods and Feeds.

Table 48	*Citrus fruit (mandarins, oranges).* Italy, Spain
Table 49	*Apples.* France, Germany, Greece, Italy, Spain
Table 50	*Peaches, Nectarines*. France, Germany, Greece, Italy, Spain

Table 51	*Cherries*. France, Germany
Table 52	*Plums*. France, Germany
Table 53	*Strawberries*. France, Germany, Italy, Spain, UK
Table 54	*Grapes*. France, Germany, Italy, Spain
Table 55	*Blackcurrants*. Germany
Table 56	*Raspberries*. France
Table 57	*Olives*. France, Greece, Italy, Portugal, Spain
Table 58	*Onions*. France, Germany, Greece, Italy, Spain, UK
Table 59	*Leeks*. France, Germany, Greece, Italy, Spain, UK
Table 60	*Broccoli, cauliflower*. France, Greece, Italy, Spain
Table 61	*Brussels sprouts*. Australia
Table 62	*Cucumber, Zucchini (Field)*. Belgium, France, Germany, Greece, Italy, Spain
Table 63	*Cucumber (Protected crop)*. Denmark, France, Germany, Greece, Italy, Spain, UK
Table 64	*Melons*. France, Germany, Greece, Italy, Spain
Table 65	*Mushrooms*. France, Germany
Table 66	*Sweet corn*. Canada, France, Germany, Italy, New Zealand, Portugal, Spain, UK
Table 67	*Tomatoes*. Australia, Denmark, Finland, France, Germany, Greece, Italy, Mexico, New Zealand, South Africa, Spain, UK
Table 68	*Peppers*. Canada, France
Table 69	*Egg plant*. France
Table 70	*Curly kale*. Germany, UK
Table 71	*Lettuce*. France, Spain
Table 72	*Spinach*. France, Germany, Italy
Table 73	*Beans (unshelled)*. France, Germany, Greece, Italy, Portugal, Spain
Table 74	*Beans (shelled)*. France, Germany
Table 75	*Peas (unshelled)*. France, Germany, UK
Table 76	*Peas (shelled)*. France, Germany
Table 77	*Lupins*. Australia
Table 78	*Pulses and lentils (stored grain)*. Brazil, France, Hungary
Table 79	*Beets (Beetroot, sugar beet)*. Belgium, France, Germany
Table 80	*Carrots*. France, Germany, Greece, Italy, Portugal, UK
Table 81	*Parsnip*. UK
Table 82	*Chicory*. France, Germany
Table 83	*Potato*. France, Germany, Greece, Portugal, Spain
Table 84	*Sweet potato*. South Africa
Table 85	*Radish*. France, Germany
Table 86	*Artichokes*. France, Germany, Greece, Italy, Spain
Table 87	*Hazelnuts*. France, Italy, Spain
Table 88	*Walnuts*. France, Germany, Italy
Table 89	*Rape*. France, Germany
Table 90	*Sunflowers*. Canada, France, Germany, Greece, Italy, Spain
Table 91	*Soya beans*. Australia, France, Côte d'Ivoire, Mexico
Table 92	*Cotton*. India, Côte d'Ivoire, Mexico, Morocco, USA
Table 93	*Wheat*. France, Germany, UK
Table 94	*Barley*. Germany, UK
Table 95	*Oats*. Germany
Table 96	*Maize (stored grain)*. France, Italy
Table 97	*Wheat (stored grain)*. Australia, Belgium, Brazil, China, France, Greece, India, Italy, Morocco, UK, USA
Table 98	*Barley (stored grain)*. France
Table 99	*Sorghum (stored grain)*. Brazil, France, USA
Table 100	*Rice (stored grain)*. Brazil, France

Table 101	*Tea*. India, Malawi, Taiwan
Table 102	*Cacao*. Côte d'Ivoire
Table 103	*Coffee (field and stored)*. Brazil, Côte d'Ivoire
Table 104	*Pasture*. Canada, New Zealand

Where residues were not detected the results are reported as below the limit of quantification (LOQ), e.g. <0.05 mg/kg. Residues, application rates and spray concentrations have generally been rounded to 2 significant figures. Although trials included results for untreated controls, these results are not reported in the Tables unless the residues in the control samples were above the LOQ. The prefix "c" indicates samples from control plots. Where possible, residues are recorded uncorrected for analytical recoveries. It should be noted that unless stated otherwise concurrent recoveries were acceptable and any corrections would be small. Analyses of replicate field samples from one plot or duplicate plots in one trial are shown separately. Double underlined residues are from treatments according to GAP and were used to estimate maximum residue levels.

Citrus fruits. In field trials in Italy, and Spain an EC formulation was applied to oranges and mandarins in the 2001 (C024730 and C024828). Plot sizes were 90-186 m^2 and application was with knapsack or motorised sprayers. In one of the trials from Spain, the farmer made an unauthorised application of deltamethrin at 14 g ai/ha 13 days before final sample was collected. Samples were stored for 46-149 days. Control samples fortified with deltamethrin at 0.01 and 0.1 mg/kg were extracted and analysed with the treated samples. The recoveries at 0.01 mg/kg were 76, 84, 75 and 73% for mandarins and 72, 87, 100 and 105% for oranges.

Table 48. Residues of deltamethrin in citrus fruits after foliar applications of EC formulations.

Location, year, variety	Application				PHI (days)	Deltamethrin (mg/kg)	Report no.
	g ai/ha	g ai/hl	l/ha	No.			
Mandarins							
Bernalda, Basilicata, Italy, 2001, Avana	15	1.0	1496	1	0 29	0.01 <u>≤0.01</u>	C024730
Palagiano, Puglia, Italy, 2001, Tondo Uscio comune	15	1.0	1500	1	0 29	0.01 <u>≤0.01</u>	C024730
Benacazòn, Andalucia, Spain, 2001, Marisol	15	1.2	1233	1	0	0.01	C024730
	15 14	1.2		2	13	0.02	C024730
La Rinconada, Andalucia, Spain, 2001, Clemenules	15	0.91	1701	1	0 30	<0.01 <u>≤0.01</u>	C024730
Huelva, Andalucia, Spain, 2001, Clemenules	15	0.86	1690	1	0 30	0.01 <u>≤0.01</u>	C024730
Oranges							
Cagnano Varano, Puglia, Italy, 2001, Washington	15	1.0	1524	1	0 29	0.01 <u>≤0.01</u>	C024828
Palagiano, Puglia, Italy, 2001, Navelina	15	1.0	1492	1	0 29	<0.01 <u>0.01</u>	C024828
Benacazòn, Andalucia, Spain, 2001, Navelina	15	0.97	1567	1	0 32	0.02 <u>0.01</u>	C024828
Santiponce, Andalucia, Spain, 2001, Navelina	15	1.0	1429	1	0 29	0.01 <u>≤0.01</u>	C024828
Benacazòn, Andalucia, Spain, 2001, Washington Navel	15	1.2	1226	1	0 30	0.01 <u>≤0.01</u>	C024828

Apples. In field trials in France, Germany, Greece, Italy and Spain EC, EG, EW and SC formulations were applied. Plot sizes were 21-88 m^2 or 3 to 20 trees and application was with knapsack or

motorised sprayers/mistblowers. Samples were stored for 7-240 days. Control samples fortified with deltamethrin were extracted and analysed with the treated samples. The method used in the trials in 1981 and 1982 in Germany was AL 40/79, and recoveries were 84% at 0.003 mg/kg in 1981 and 72-115% (fortification not specified) in 1982. In the trials in France, Greece, Spain and Italy in 1996 the method was RESID 96/10, and recoveries from samples fortified at 0.02 mg/kg were 94, 85, 77, 102 and 93%, and in the 2000 trials method DGM F0 1/97-1 was used and recoveries from samples fortified at 0.01 mg/kg were 131, 124, 116, 103, 98, 127 and 119%.

Table 49. Residues of deltamethrin in apples after foliar applications of various deltamethrin formulations.

Location, year, variety	Application					PHI	Deltamethrin	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Poitou-Charentes, France 1996, Golden Delicious	EG	13	0.94	1300	5	0 7	0.03 <u>0.02</u>	A74166
Lamothe Landeron, Aquitaine, France, 2000, Galla	EC	13	1.6	800	3	0 1 3 7	0.01 0.02 0.01 <u>0.02</u>	C017035
Lamothe Landeron, Aquitaine, France, 2000, Galla	EG	13	1.6	800	3	0 1 3 7	0.01 0.01 <0.01 <u>0.02</u>	C017035
Lamothe Landeron, Aquitaine, France, 2000, Galla	EW	13	1.6	800	3	0 1 3 7	0.02 0.02 0.02 <u>0.02</u>	C017035
Saint Vincent de Paul, Aquitaine, France, 2000, Elstar	EC	13	2.5	500	3	0 1 3 7	0.07 0.04 0.03 <u>0.03</u>	C017035
Saint Vincent de Paul, Aquitaine, France, 2000, Elstar	EG	13	2.5	500	3	0 1 3 7	0.06 0.03 0.03 <u>0.03</u>	C017035
Saint Vincent de Paul, Aquitaine, France, 2000, Elstar	EW	13	2.5	500	3	0 1 3 7	0.04 0.05 0.03 <u>0.04</u>	C017035
Kruemse, Germany, 1981, James Grieve	EC	11	0.75	1500	5 (14)	0 3 5 7	0.05 0.06 0.04 <u>0.05</u>	A24891
Langenau Albeck, Germany, 1981, Goldpermaene	EC	11	0.75	1500	5 (14)	0 3 5 7	0.07 0.06 0.04 <u>0.07</u>	A24892
Langenau Albeck, Germany, 1981, Golden Delicious	EC	11	0.75	1500	5 (14)	0 3 5 7	0.07 0.05 0.05 <u>0.06</u>	A24893
Kruemse, Germany, 1981, James Grieve	EC	11	0.75	1500	5 (14)	0 3 5 7	0.05 0.04 0.03 <u>0.05</u>	A24906
Langenau Albeck, Germany, 1981, Goldpermaene	EC	11	0.75	1500	5 (14)	0 3 5 7	0.09 0.07 0.04 <u>0.08</u>	A24907

Location, year, variety	Application					PHI	Deltamethrin	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Langenau Albeck, Germany, 1981, Golden Delicious	EC	11	0.75	1500	5 (14)	0 3 5 7	0.06 0.07 0.09 0.05	A24908
Rosenweide, Germany, 1982, Golden Delicious	EC	11	0.75	1500	5 (15)	0 3 5 7	0.06 0.06 0.05 0.06	A25162
Bornheim, Germany, 1982, Klarapfel	EC	11	0.75	1500	5 (15)	0 3 5 7	0.02 0.02 0.03 0.02	A25163
Langenau Albeck, Germany, 1982, Golden delicious	EC	11	0.75	1500	5 (18)	0 3 5 7	0.06 0.03 0.04 0.04	A25164
Hattersheim, Germany, 1982, Roter Jonathan	EC	11	0.75	1500	5 (14)	0 3 5 7	0.03 0.03 0.02 0.02	A25165
Rosenweide, Germany, 1982, Golden delicious	SC	11	0.75	1500	5 (15)	0 3 5 7	0.06 0.05 0.06 0.05, 0.06 (0.06 av)	A25174
Bornheim, Germany, 1982, Klarapfel	SC	11	0.75	1500	5 (14)	0 3 5 7	0.02 0.02 - 0.01, 0.02 (0.02 av)	A25175
Langenau Albeck, Germany, 1982, Golden delicious	SC	11	0.75	1500	5 (18)	0 3 5 7	0.03 0.03 0.01 0.01, 0.01 (0.01 av)	A25176
Hattersheim, Germany, 1982, Roter Jonathan	SC	11	0.75	1500	5 (14)	0 3 5 7	0.05 0.03 0.03 0.03, 0.04 (0.04 av)	A25177
Rosenweide, Germany, 1982, Golden Delicious	SC	11	0.75	1500	5 (15)	0 3 5 7	0.02 0.05 0.06 0.04, 0.05 (0.05 av)	A25375
Bornheim, Germany, 1982, Klarapfel	SC	11	0.75	1500	5 (14)	0 3 5 7	0.01 0.02 0.02 0.01, 0.01 (0.01 av)	A25406
Langenau Albeck, Germany, 1982, Golden Delicious	SC	11	0.75	1500	5 (18)	0 3 5 7	0.03 0.05 0.02 0.02, 0.03 (0.03 av)	A25407
Hattersheim, Germany, 1982, Roter Jonathan	SC	11	0.75	1500	5 (14)	0 3 5 7	0.04 0.06 0.03 0.02, 0.03 (0.03 av)	A25408
Macedonia, Greece, 1996, Smouth	EG	24 25	0.5 0.5	4900 5100	5	0 7	0.02 0.02	A74166

Location, year, variety	Application					PHI (days)	Deltamethrin (mg/kg)	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.			
		22 27 24	0.44 0.5 0.5	4800 5300 4900				
Macedonia, Greece, 2000, Granny Smith	EC	13	0.8	1500	3	0 1 3 7	<0.01 <0.01 <0.01 <0.01	C017035
Macedonia, Greece, 2000, Granny Smith	EG	13	0.8	1500	3	0 1 3 7	0.02 0.01 0.01 0.02	C017035
Macedonia, Greece, 2000, Granny Smith	EW	13	0.8	1500	3	0 1 3 7	0.02 0.01 0.02 0.02	C017035
Emilia Romagna, Italy 1996, Stayman	EG	13	0.81	1500	5	0 7	0.05 0.02	A74166
Emilia-Romagna, Italy, 2000, Nero Rome Red	EC	13	0.8	1500	3	0 1 3 7	0.04 0.04 0.03 0.04	C017035
Emilia-Romagna, Italy, 2000, Nero Rome Red	EG	13	0.8	1500	3	0 1 3 7	0.04 0.04 0.03 0.03	C017035
Emilia-Romagna, Italy, 2000, Nero Rome Red	EW	13	0.8	1500	3	0 1 3 7	0.05 0.04 0.03 0.04	C017035
Aragon, Spain, 1996, Golden 972	EG	13	0.81	1500	5	0 7	0.03 0.04	A74166
Comunidad Valenciana, Spain, 2000, Starking	EC	13	1.3	1000	3	0 1 3 7	0.03 0.04 0.04 0.03	C017035
Comunidad Valenciana, Spain, 2000, Starking	EG	13	1.3	1000	3	0 1 3 7	0.03 0.04 0.02 0.04	C017035
Comunidad Valenciana, Spain, 2000, Starking	EW	13	1.3	1000	3	0 1 3 7	0.04 0.03 <0.01 0.02	C017035
Comunidad Valenciana, Spain, 2000, Reineta	EC	13	1.3	1000	3	0 1 3 7	0.04 0.04 0.03 0.03	C017035
Comunidada Valeniana, Spain, 2000, Reineta	EG	13	1.3	1000	3	0 1 3 7	0.05 0.04 0.02 0.04	C017035
Comunidad Valenciana, Spain, 2000, Reineta	EW	13	1.3	1000	3	0 1 3 7	0.05 0.05 0.03 0.07	C017035

Peaches and nectarines. In field trials in France, Germany, Greece, Italy and Spain EC and EG formulations were applied to plots of 60-324 m^2 with knapsack or motorised sprayers/mistblowers. Samples were stored for 4 to 10 months. Control samples fortified with deltamethrin were extracted

and analysed with the treated samples. The method used in the 1978 German trials was not specified but was by GC/ECD, recovery at 0.02 mg/kg 100%. Method RESID 96/10 was used for the 1996 trials in France, Italy and Spain in which recoveries were 80±2.5% at 0.025 mg/kg, and also for other 1996 trials in France, Greece, Italy and Spain, in which recoveries from samples fortified at 0.02 mg/kg were 74 and 69%. In most trials it was not clear whether the residue was reported in the whole fruit or fruit without stone.

Table 50. Residues of deltamethrin in peaches and nectarines after foliar applications of EG and EC deltamethrin formulations.

Location, year, variety	Application					PHI (days)	Deltamethrin (mg/kg)	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.			
St Vincent, France, 1995, Flavorgold (nectarine)	EG	7.5×3, 15	1.3×3, 2.5	600	4	7	<0.05	A56981
Meynes, France, 1995, Baby Gold 9	EG	7.5×3, 15	1.3×3, 2.5	600	4	0 7	<0.05 <0.05	A56981
Midi-Pyénées, France 1996, Bienvenue	EG	18	2.2	800		0 7	0.05 <0.02	A74186
Kriftel, Germany, 1978, Früher Alexander	EC	19	1.3	1500	3 (26)	0 3 5 7	0.1 0.05 0.04 0.03	A15735
Hattersheim, Germany, 1978, Dixi Red	EC	19	1.3	1500	3 (21)	0 3 5 7	0.04 0.03 0.02 0.03	A15736
Hattersheim, Germany, 1978, Red Haeven	EC	19	1.3	1500	3 (21)	0 3 5 7	0.06 0.02 0.04 0.02	A15737
Trani, Italy, 1995, Baby Gold 7	EG	7.5×3, 15	0.63×3, 1.3	1200	4	0 7	<0.05 <0.05	A56981
Sevilla, Spain, 1995, Sudanell	EG	7.5×3, 15	1.5×3, 3	500	4	0 7	<0.05 <0.05	A56981
Andalucia, Spain, 1996, Sudanell	EG	18	3.5	500		0 7	<0.02 <0.02	A74186
Macedonia, Greece, 1996, Loatev	EG	18	0.69	2500		0 7	<0.02 <0.02	A74186
Emilia Romagna, Italy, 1996, Star Gold Red	EG	18	1.8	1000		0 7	0.04 0.03	A74186

Cherries. In field trials in France and Germany an EC formulation was applied to plots of 80-210 m^2 (4-5 trees) with knapsack or motorised sprayers/airblast sprayers. The storage period was 7 months for the 1994 trials and 110-133 days for those in 2001. Control samples fortified with deltamethrin were extracted and analysed with the treated samples. The method used in the 1994 trials in Germany was not specified but was by GC/ECD, recovery at 0.02 mg/kg 73%. Method AGR/MOA/DEL-1, based on Manual of Pesticide Residue Analysis, DFG 1992 volume II S23, p333-342, was used for the trials in 2001 in France and Germany. Recoveries were 92, 89 and 103% from samples fortified at 0.01 mg/kg.

Table 51. Residues of deltamethrin in cherries after EC foliar applications.

Location, year, variety	Application				PHI (days)	Deltamethrin (mg/kg)	Report no.
	g ai/ha	g ai/hl	l/ha	No.			
Ouveillan, France, 1994, Napoleon	13	2.1	600	3	7	0.11 (0.1 whole fruit)	A71524
Saint Gilles, France, 1994, Hedelfingen	13	1.5	850	3	7	<0.02 pulp (≤0.018 whole fruit)	A71524
Vers Pont du Gard, France,	13	1.3	1000	3	7	0.17 pulp (0.15	A71524

Location, year, variety	Application				PHI	Deltamethrin	Report no.
	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
1994, Blanch Napoleon						whole fruit)	
Jussy, Bourgogne, France, 2001, Marmotte	18	2.9	620	3	0 1 3 7	0.07 pulp 0.06 pulp 0.02 pulp 0.02 pulp	C023142
Coulanges-la-Vineuse, Bourgogne, France, 2001, Marmotte	18	2.9	620	3	0 1 3 7	0.10 pulp 0.12 pulp 0.07 pulp 0.04 pulp	C023142
Ablaß, Sachsen, Germany, 2001, Schattenmorelle	18	1.8	1000	3	0 1 3 7	0.05 pulp 0.05 pulp 0.07 pulp 0.04 pulp	C023142

Plums. In field trials in France and Germany an EC formulation was applied. Plot sizes were 90-480 m^2 and application was with knapsack or motorised airblast sprayers. The storage period was 6 months for the trials in France in 1979 and 68-72 days for those in France and Germany in 2001. Control samples fortified with deltamethrin were extracted and analysed with the treated samples. The method used in the trials in 1979 was RU-78.11.07/9 (GC/ECD, recovery at 0.02 mg/kg 73%) and for trials in 2001 in France and Germany method AGR/MOA/DEL-1 with recoveries of 101, 74, 89, 87 and 108% from samples fortified at 0.01 mg/kg.

Table 52. Residues of deltamethrin in plums after foliar EC applications.

Location, year, variety	Application				PHI	Deltamethrin	Report no.
	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Comps, France, 1979, Allo	18	1.3	1400	2	2 4 7 13	0.018 0.009 0.009 <0.005	A20618
Comps, France, 1979, Allo	18	1.3	1400	2	2 4 7 13	0.006 0.005 0.005 <0.005	A72938
Thillot-sous-les-Côtes, Lorraine, France, 2001, Mirabelle de Nancy	18	2.9	620	3	0 3 7 14 21	0.02 (0.02 pulp) 0.04 (0.04 pulp) 0.02 (0.02 pulp) 0.02 (0.02 pulp) 0.04 (0.04 pulp)	C024830
Viéville-sous-les-Côtes, Lorraine, France, 2001, Quetsche	18	2.9	620	3	0 3 7 14 21	0.02 (0.02 pulp) 0.02 (0.02 pulp) 0.03 (0.03 pulp) 0.02 (0.02 pulp) 0.01 (0.01 pulp)	C024830
Ablaß, Sachsen, Germany, 2001, Valor	18	1.8	1000	3	0 3 7 14 21	<0.01 (0.01 pulp) <0.01 (<0.01 pulp) <0.01 (0.01 pulp) 0.02 (0.02 pulp) <0.01 (0.01 pulp)	C024830
Höhnstedt, Anhalt, Germany, 2001, Hauszwetsche	18	1.8	1000	3	0 3 7 14 21	0.02 (0.02 pulp) <0.01 (<0.01 pulp) <0.01 (<0.01 pulp) <0.01 (<0.01 pulp) <0.01 (<0.01 pulp)	C024830

Strawberries. In field and protected (plastic tunnel and glasshouse) trials in France, Germany, Italy, Spain and the UK EC, EG and EW formulations were applied to plots of 8-42 m^2 with knapsack or motorised bicycle/wheelbarrow sprayers. The storage period for samples was 8-12 months. Control samples fortified with deltamethrin were extracted and analysed with the treated samples. In the trials in France in 1993 a GC/ECD method was used (recovery at 0.08 mg/kg 84%), and in 1994 and 1995

method V.974/VEG/01/01. Recoveries from samples fortified at 0.01 mg/kg were 100, 100 and 109% and at 0.05 mg/kg 91±14% (n=38). Method DGM F01/97-1 was used for the trials in 2000 with recoveries from samples fortified at 0.02 mg/kg of 87, 78, 118, 115, 108, 114, 97 and 112%.

Table 53. Residues of deltamethrin in strawberries after foliar applications of various deltamethrin formulations.

Location, year, variety	Application					PHI	Deltamethrin	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Fontaines en Sologne, France, 1993, Selva	EC	13	6.3	200	4	3	0.02	A71564
Reynies, France, 1993, Elsanta (plastic tunnel)	EC	13	3.8	330	4	3	0.05	A71564
St Cocumont, France 1993, Selva (glasshouse)	EC	13	6.3	200	4	3	0.03	A71564
Meauzac, France, 1993, Mara des Bois (plastic tunnel)	EC	13	3.8	330	4	3	0.04	A71564
Bieujac, Aquitaine, France, 1994, Selva (plastic tunnel)	EG	13	6.3	200	3	0 1 3	0.04 0.02 0.03	A55222
Beauvoisin, Languedoc-Roussillon, France, 1994, Mara des Bois (plastic tunnel)	EG	13	6.3	200	3	0 1 3	0.03 0.04 0.03	A55222
Reynies, Midi Pyrenees, France, 1995, Gariguette	EG	13	1.3	1000	3	0 1 3	0.02 0.02 0.02	A56783
Reynies, Midi Pyrenees, France, 1995, Elsanta	EG	13	1.3	1000	3	0 1 3	0.03 0.02 0.02	A56783
Clery-En-Vexin, Ile de France, France, 2000, Gariguette	EG	13		300	2	0 1 3	<0.02 <0.02 <0.02	C016894
Clery-En-Vexin, Ile de France, France, 2000, Gariguette	EC	13		262 300	2	0 1 3	<0.02 <0.02 <0.02	C016894
Clery-En-Vexin, Ile de France, France, 2000, Gariguette	EW	13		300	2	0 1 3	<0.02 <0.02 <0.02	C016894
Meckenheim, Rheinland-Pflaz, Germany, 2000, Elsanta	EG	13	2.1	600	2	0 1 3	<0.02 <0.02 <0.02	C016894
Meckenheim, Rheinland-Pflaz, Germany, 2000, Elsanta	EC	13	2.1	600	2	0 1 3	<0.02 <0.02 <0.02	C016894
Meckenheim, Rheinland-Pflaz, Germany, 2000, Elsanta	EW	13	2.1	600	2	0 1 3	<0.02 <0.02 <0.02	C016894
Swisttal-Miel, Nordrhein-Westfalen, Germany, 2000, Elsanta	EG	13	2.1	600	2	0 1 3	0.04 <0.02 <0.02	C016894
Swisttal-Miel, Nordrhein-Westfalen, Germany, 2000, Elsanta	EC	13	2.1	600	2	0 1 3	0.04 0.03 <0.02	C016894
Swisttal-Miel, Nordrhein-Westfalen, Germany, 2000, Elsanta	EW	13	2.1	600	2	0 1 3	0.04 0.03 <0.02	C016894

Location, year, variety	Application					PHI	Deltamethrin	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Wurzen-Roitzsch, Sachsen, Germany, 2000, Korona	EG	13		300	2	0 1 3	<0.02 <0.02 <u>≤0.02</u>	C016894
Wurzen-Roitzsch, Sachsen, Germany, 2000, Korona	EC	13		300	2	0 1 3	0.02 <0.02 <u>≤0.02</u>	C016894
Wurzen-Roitzsch, Sachsen, Germany, 2000, Korona	EW	13		300	2	0 1 3	<0.02 0.02 <u>≤0.02</u>	C016894
Argelato, Emilia Romagna, Italy, 1995, Marmolada	EG	13	1.3	1000	3	0 1 3	0.02 0.01 <u>≤0.01</u>	A56783
Almonté, Andalucia, Spain, 1995, Tudla	EG	13	1.3	1000	3	0 1 3	0.07 0.08 <u>0.06</u>	A56783
Rociana del Condado, Andalucia, Spain, 1995, Oso-Grande	EG	13	1.3	1000	3	0 1 3	0.05 0.07 <u>0.1</u>	A55222
Villarrasa, Andalucia, Spain, 1995, Oso-Grande	EG	13	1.3	1000	3	0 1 3	0.06 0.05 <u>0.03</u>	A55222
Norwich, Norfolk, UK, 2000, Elsanta	EG	13		600	2	0 1 3	0.05 0.04 <u>0.03</u>	C016894
Norwich, Norfolk, UK, 2000, Elsanta	EC	13		600	2	0 1 3	0.03 0.02 <u>0.02</u>	C016894
Norwich, Norfolk, UK, 2000, Elsanta	EW	13		600	2	0 1 3	0.04 0.04 <u>0.03</u>	C016894

<u>Grapes (wine and table)</u>. In field trials in France, Germany, Italy and Spain an EC formulation was applied to wine grapes. Plot sizes were 24-53 m^2 and application was with knapsack/backpack or motorised sprayers or by airblast sprayer. The storage period was 19-175 days. Control samples fortified with deltamethrin were extracted and analysed with the treated samples. The method used in the trials was AGR/MOA/DEL-1 (recoveries at 0.01 mg/kg 92±11%). Trials on table grapes in France and Germany in 2001 were reported in summary with recoveries from method AGR/MOA/DEL-1 of 106 ± 3% from samples fortified at 0.01-0.1 mg/kg.

Table 54. Residues of deltamethrin in wine and table grapes after foliar applications of EC formulations.

Location, year, variety	Application				PHI	Deltamethrin	Report no.
	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Wine grapes							
Sorgues, Provence, France, 2001, Grenache	7.8 18 17	2.3 5.4 5.4	333 326 309	3	0 7	0.04 <u>0.01</u>	C024159
Brimont, Champagne, France, 2001, Pinot Meunier	7.2 17×2	2.5 5.8×2	296 300×2	3	0 7 14 21 28	0.07 <u>0.03</u> <0.01 0.01 <0.01	C024717

Location, year, variety	Application				PHI	Deltamethrin	Report no.
	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Noizay, Centre, France, 2001, Chenin	7.7 19×2	1.5 3.6×2	497 524×2	3	0 7 14 21 28	<0.01 0.01 <0.01 0.02 0.01	C024717
Bourgueil, Centre, France, 2001, Cabernet Franc	7.7 18×2	1.5 3.5×2	507 505×2	3	0 7 21	0.03 0.03 0.03	C024717
Radebeul, Saxony, France, 2001, Riesling	7.5 18×2	0.9 2.2×2	800	3	0 7 14 21 28	0.03 0.05 0.02 0.03 0.02	C024717
Zeil am Main, Bavaria, Germany, 2001, Kerner	7.5 18×2	0.9 2.2×2	800	3	0 7 14 21 28	0.01 0.02 0.01 0.01 0.01	C024717
Piateda, Lombardia, Italy, 2001, Nebbiolo	7.6 18 17	1.2 2.9 2.9	612 616 596	3	0 7	0.10 0.09	C024159
Jerez de la Frontera, Andalucia, Spain, 2001, Palomino	7.6 16 17	0.8 1.9 2.0	936 860 815	3	0 7	0.07 0.07	C024159
Table grapes							
Mazan, Provence, France, 2001, Muscat de Hamburg	8.1 17 18	2.5 5.8 5.8	325 283 308	3	0 7 11 14	0.04 0.06 0.04 0.05	C024059
Ordona, Foggia, Italy, 2001, Italia	7.6 18 17	0.94 2.2 2.2	805 801 794	3	0 7 11 14	0.06 0.06 0.06 0.01	C024059
Bollullos del condado, Andalucia, Spain, 2001, Cardinal	7.6 17 18	0.90 2.2 2.2	838 806 798	3	0 7 11 14	0.02 0.01 0.01 0.03	C024059

Currants. In field trials in Germany an EC formulation was applied to blackcurrants. Plot sizes were 21 m^2 and 6-16 plants. The storage period for samples was 1-4 months. Control samples fortified with deltamethrin were extracted and analysed with the treated samples. The method used was AL40/79 (recoveries at 0.0004 mg/kg 90% and at 0.0075 mg/kg 78%).

Table 55. Residues of deltamethrin in blackcurrants after foliar applications of EC formulations.

Location, year, variety	Application				PHI	Deltamethrin	Report no.
	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Elbsdorf, Germany, 1981, Silvergieters	19 11 11	1.3 0.69 0.69	1500 1500 1500	3	0 3 5 7	0.2 0.2 0.2, 0.2 (0.2 av) 0.2, 0.2 (0.2 av)	A25136
Over, Germany, 1981, Silvergieters	19 11 11	1.3 0.69 0.69	1500 1500 1500	3	0 3 5 7	0.3 0.3 0.2, 0.2 (0.2 av) 0.2, 0.3 (0.3 av)	A25137
Bonheim, Germany, 1981, Silvergieters	11	0.72	1500	3	0 3 5 7	0.5 0.3 0.2 0.3	A25138

Location, year, variety	Application				PHI	Deltamethrin	Report no.
	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Sossenheim, Germany, 1981, Silvergieters	11	0.72	1500	3	0 3 5 7	0.07 0.02 0.10 0.08	A25139

Raspberries. In field trials in France with an EC formulation plot sizes were 8 and 24 m^2 (6 and 80 plants). The storage period for samples was 4 months. Control samples fortified with deltamethrin were extracted and analysed with the treated samples. A GC/ECD method (not specified) was used (recovery at 0.04 mg/kg 84%).

Table 56. Residues of deltamethrin in raspberries after foliar applications of EC formulations.

Location, year, variety	Application				PHI	Deltamethrin	Report no.
	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Les Alluets le Roi, Bassin Parisien, France, 1994, Heritage	13	6.3	200	3	7 12 13	0.04 0.03 <0.02	A71566
Gerland, Bourgogne, France, 1994, Preussen	13	6.3	200	3	7	<0.02	A71566

Olives. In field trials in France, Greece, Italy, Portugal and Spain (1997-2000) an EG formulation was applied by knapsack sprayers or mistblowers. Plot sizes in 1997 were 179-294 m^2 and the storage period for samples was 532-542 days. The other storage periods were 121-243 days for the 1998 trials and 202-299 days for the 2000 trials. The method used in 1997 and 1998 was DGM F01/97-0: recoveries at 0.05 mg/kg were 93 and 81% in 1997 and 83, 88, 90 and 80% in 1998. The method used in the 2000 trials was AGR/MOA/DEL-1 and recoveries from olives fortified at 0.01 mg/kg were 104, 74, 99, 97 and 92%.

Table 57. Residues of deltamethrin in olives after foliar applications of EG formulations.

Location, year, variety	Application				PHI	Deltamethrin	Report no.
	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Sommieres Languedoc-Roussillon, France 1997, Picholine	13	1.3	1000	4	0 7	0.6 0.54	C010147
Beaumes de Venise, France 1997, Verdale	13×3, 18	1.3×3, 1.8	1000	4	0 7	0.41 0.22	C010147
Kolindros Macedonia, Greece 2000, Chalkidikis	15	1	1500	4	0 3 7 0 3 7	0.03 pulp 0.05 pulp 0.04 pulp 0.02 whole fruit 0.04 whole fruit 0.02 whole fruit	C016290
Trani Puglia, Italy 1998, Gratina	15	1.5	1000	4	0 3 7 0 3 7	0.20 pulp 0.16 pulp 0.18 pulp 0.14 whole fruit 0.11 whole fruit 0.12 whole fruit	C005160
Andria Puglia, Italy 2000, Coratina	15	1	1500	4	0 3 7 0 3 7	0.37 pulp 0.31 pulp 0.31 pulp 0.14 whole fruit 0.16 whole fruit 0.14 whole fruit	C016290

Location, year, variety	Application				PHI	Deltamethrin	Report no.
	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Ribatejo E Oeste, Portugal, 2000, Picoal	15	1.3	1149	4	0 3 7 0 3 7	0.26 pulp 0.23 pulp 0.25 pulp 0.17 whole fruit 0.14 whole fruit 0.15 whole fruit	C016290
Pau, Catalunia, Spain, 1997, Argudell	13×3, 18	1.3×3, 1.8	1000	4	0 7	0.6 0.44	C010147
Paradas, Andalucia, Spain 1998, Manzanillo	15	2.5	600	4	0 3 7 0 3 7	0.14 pulp 0.15 pulp 0.14 pulp 0.11 whole fruit 0.12 whole fruit 0.12 whole fruit	C005160
Osuna, Andalucia, Spain 2000, Verdial	15	1	1500	4	0 3 7 0 3 7	0.22 pulp 0.15 pulp 0.21 pulp 0.17 whole fruit 0.12 whole fruit 0.18 whole fruit	C016290

Onions. In field trials in France, Greece, Germany, Italy, Spain and the UK EC and EG formulations were applied. Plot sizes in France, Germany, Italy and Spain in 1997 and 1998 were 11-62 m^2. The storage period for samples was 43-444 days. Control samples fortified with deltamethrin were analysed with the treated samples by method DGM F01-97-0. Recoveries from samples fortified at 0.02 mg/kg were 58 and 95, 106, 86, 125, 126, 134 and 127%. Plot sizes in other trials in Germany in 1977 were 8-20 m^2 and using method AL 2/77 recoveries from leaves and onions fortified at 0.01 mg/kg were 90 and 89% respectively.

Table 58. Residues of deltamethrin in onions after foliar applications of EC and EG formulations.

Location, year, variety	Application					PHI	Deltamethrin	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Gramont, France, 1992, Copra	EC	7.5	1.9	400	4	20	<0.015	A71606
Jegun, France, 1992, Copra	EC	7.5	1.9	400	3	17	<0.015	A71606
Epone Ile de France, France, 1997, Rostore	EG	13	5.0	250	3	0 7	<0.02[1] ≤0.02	A74344
Layrac Aquitaine, France, 1997, Apix	EG	13, 9.5, 13	5, 3.8, 5	250	3	0 7	<0.02 ≤0.02	C001500
Nezel/Lafalaise Ile de France, France 1998 Boston F1	EG	13	5	250	3	0 3 7	<0.02 <0.02 ≤0.02	C004595
Aulnay Ile de France, France 1998 Legio	EG	13	5	250	3	0 3 7	<0.02 <0.02 ≤0.02	C004595
Layrac Aquitaine, France, 1998, Burgos	EG	13	4.2	300	3	0 3 7	<0.02 <0.02 ≤0.02	C004596
Gersthofen, Germany, 1977, Rote Höri	EC	13	2.1	600	2	0 0 3 3 5 5 7 7 14	0.2 leaf 0.03 onion 0.04 leaf 0.07 onion 0.03 leaf 0.02 onion 0.02 leaf 0.02 onion 0.03 onion	A13524

Location, year, variety	Application					PHI	Deltamethrin	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Hattersheim, Germany, 1977, Zittauer gelbe	EC	13	2.1	600	2	0 0 3 3 5 5 7 7 14 14	0.05 leaf 0.04 onion 0.01 leaf 0.03 onion 0.02 leaf 0.05 onion 0.03 leaf 0.02 onion 0.03 leaf 0.03 onion	A13525
Stelle Harburg, Germany, 1977, Zittauer gelbe	EC	13	2.1	600	2	0 0 3 3 5 7 14 14	0.4 leaf 0.04 onion 0.1 leaf 0.05 onion 0.1 onion 0.09 leaf 0.09 leaf 0.04 onion	A13526
Donaualtheim Bayern, Germany 1997, Hilten	EG	13	4.2	300	3	0 8	<0.02 <0.02	A74344
Trebur Hessen, Germany 1997, Summit F1	EG	13	4.2	300	3	0 8	<0.02 <0.02	A74344
Wiedemar Sachsen, Germany 1997, Corona	EG	13	4.2	300	3	0 7	<0.02 <0.02	A74344
Gersthofen Bayern, Germany, 1998, Matcho	EG	13	4.2	300	3	0 3 7	<0.02 <0.02 <0.02	C004595
Kölsa Sachsen, Germany 1998, Armstrong	EG	13	4.2	300	3	0 3 7	0.08 0.08 0.03	C004595
Epanomi, Macedonia, Greece 1997, Delvano	EG	13, 16, 13	2.5, 3.3, 2.5	500	3	0 7	<0.02 <0.02	C001500
Cadriano Emilia Romagna, Italy, 1997, Tamara	EG	13	4.2	300	3	0 7	<0.02 <0.02	C001500
Granarolo Emilia Romagna, Italy, 1997, Tamara	EG	13	4.2	300	3	0 7	<0.02 <0.02	C001500
Zapponeta, Puglia, Italy 1998, Blancador	EG	13	2.5	500	2	0 7	<0.02 <0.02	C004596
Benifaio Valencia, Spain, 1997, Balosa	EG	13	4.2	300	3	0 7	<0.02 <0.02	C001500
Palma del Rio Andalucia, Spain 1998, Atalaya	EG	13	4.2	300	3	0 3 7	<0.02 <0.02 <0.02	C004596
Lora del Rio Andalucia, Spain 1998, Rapid	EG	13	4.2	300	3	0 3 7	<0.02 <0.02 <0.02	C004596
Preston, UK, 1978, Fenland global	EC	19	1.9	1000	1	52	<0.01	A71606

[1] the whole skin removed from bulb instead of the easily detachable skin

Leeks. In field trials in France, Greece, Germany, Italy, Spain and the UK an EG formulation was applied. Reports of the 1997 trials were in summary form only. Plot sizes in France, Germany, Italy and Spain in 1998 and 1999 were 12-45 m^2. The storage period for samples was 47-234 days. Control samples fortified with deltamethrin were extracted and analysed with the treated samples. The method used in 1998 and 1999 was DGM F01-97-0. Recoveries from samples fortified at 0.02 mg/kg were 112, 118, 113 and 111%.

Table 59. Residues of deltamethrin in leeks after four foliar applications of EG formulations.

Location, year, variety	Application			PHI	Deltamethrin	Report no.
	g ai/ha	g ai/hl	l/ha	(days)	(mg/kg)	
Vendeuvre du Poitou, Poitou-Charentes, France 1997, Silfride	13	5.0	250	0 7	0.10 0.04	C001463
Bouafle, Ile de France, France, 1999, St Victor	13	5.0	250	0 3 7	0.12 0.12 0.09	C005162
Gundelfingen, Bayern, Germany, 1998, Prelina	13	4.2	300	0 3 7	0.15 0.12 0.07	C005162
Swisttal-Miel, Nordrhein-Westfalen, Germany, 1998, Rami	13	4.2	300	0 3 7	0.04 0.05 ≤0.02	C005162
Bornheim, Nordrhein-Westfalen, Germany, 1999, Prelina	13	4.2	300	0 7	0.08 0.03	C009199
Chalcidona, Macedonia, Greece, 1997, Kalemi	13	4.2	300	0 7	0.16 0.04	C001463
Lusia, Regio Veneta, Italy, 1997, Joland	13	4.2	300	0 7	0.16 0.04	C001463
Lusia, Regio Veneta, Italy, 1997, Atal	13	4.2	300	0 7	0.10 0.04	C001463
Alcacer, Valencia, Spain 1997, Carentan	13	4.2	300	0 7	0.15 <0.02	C001463
Moulton, East Anglia, UK, 1998, Prelina	13	4.2	300	0 3 7	0.21 0.14 0.13	C005162
East Winch, East Anglia, UK, 1999, Uptan F1 Hybrid	13	4.2	300	0 7	0.09 0.08	C009199

Cauliflower and broccoli. An EG formulation was applied in field trials in France, Greece, Italy and Spain in 1997 and 1998. Plot sizes were 22-67 m^2. The storage period for samples was 119-255 days. Control samples fortified with deltamethrin were analysed with the treated samples by method DGM F01-97-0. Recoveries from samples fortified at 0.02 mg/kg were 77, 88, 80 and 86%.

Table 60. Residues of deltamethrin in cauliflower and broccoli after foliar applications of EG formulations.

Location, year, variety	Application				PHI	Deltamethrin	Report no.
	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Caudecoste Aquitaine, France, 1997, Marathon (broccoli)	13	5	250	2	0 7	<0.02 ≤0.02	C001462
Serignac Aquitaine, France, 1998, Lord	13	4.2	300	2	0 7	<0.02 ≤0.02	C005163
Kastanas Macedonia, Greece, 1997, Candid crown	13	2.5	500	2	0 7	<0.02 ≤0.02	C001462
Chalcidona Thessaloniki, Greece, 1998, Linourian	13	2.5	500	2	0 7	<0.02 ≤0.02	C005163
Cadriano Emilia Romagna, Italy, 1997, Atena	13	2.5	500	2	0 7	<0.02 ≤0.02	C001462
Trani, Puglia, Italy, 1997, Marathon (broccoli)	13	2.1	600	2	0 7	0.02 ≤0.02	C001462
Ascoli Satriano, Puglia, Italy 1998, Greenbelt (broccoli)	13	2.1	600	2	0 7	0.06 0.04	C005163
Alboixech Valencia, Spain 1997, Cristina	13	4.2	300	2	0 7	<0.02 <0.02	C001462

Location, year, variety	Application				PHI	Deltamethrin	Report no.
	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Brenes/Sevilla, Andalucia, Spain 1998, Candid charm	13	4.2	300	2	0 7	<0.02 <0.02	C005163

Brussels sprouts. Trials were conducted in Tasmania, Australia, using an EC formulation. Plot sizes were not reported. The analytical method used was "Quantitative determination of decamethrin residues in plant tissues", PD/JL/2478, with recoveries from a sample fortified at 1 mg/kg of 97%.

Table 61. Residues of deltamethrin in Brussels sprouts after foliar applications of EC formulations, Tasmania, Australia, 1980.

Location	Application					PHI	Deltamethrin	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Kindred	EC	13	4.1	307	6 (32)	1 7	≤0.05 <0.05	C019314
Kindred	EC	7.5	2.4	307	6 (32)	1 7	<0.05 <0.05	C019314

Cucumbers and zucchini. Field trials in France, Germany, Greece, Italy and Spain were with EC and EG formulations. Plot sizes in Germany in 1980 were 20-40 m^2 and in France, Greece, Italy and Spain in 1997 and 1998 22-100 m^2. The storage period for samples was 38-338 days for the 1997 and 1998 trials. Control samples fortified with deltamethrin were extracted and analysed with the treated samples. The method used in Germany in 1980 was AL40/97, and in the 1997 and 1998 trials DGM F01-97-0. Recoveries from samples fortified at 0.02 mg/kg were 106, 118, 111 and 124%. A trial in Belgium in 1977 was reported in summary form only.

Table 62. Residues of deltamethrin in cucumbers and zucchini (outdoor) after foliar applications of EC and EG formulations.

Location, year, variety	Application					PHI	Deltamethrin	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Meerle, Belgium, 1977, Levo (Gherkin)	EC	38	3.8	1000	1	0 1 2 3 4 5 7	0.08 0.05 0.04 0.03 0.02 0.008 0.002	
St Nicolas de la Balerme, Aquitaine, France 1997, Cora (zucchini)	EG	13	5	250	4	0 3 7	<0.02 ≤0.02 <0.02	C002581
Ayguemorte les Graves, Aquitaine, France 1998, Coral (zucchini)	EG	13	5	250	4	0 3	<0.02 ≤0.02	C005161
Hattersheim, Germany, 1980, Delikateß	EC	13	2.1	600	3	0 1 2 3	<0.01 <0.01 <0.01 ≤0.01	A20500
Stelle, Germany, 1980, Delikateß	EC	13	2.1	600	3	0 1 2 3	<0.01 <0.01 <0.01 ≤0.01	A20501
Bornheim, Germany, 1980, Riesenschäl	EC	13	2.1	600	3	0 1 2 3	<0.01 <0.01 <0.01 ≤0.01	A20502
Gersthofen, Germany, 1980, Sensation	EC	13	2.1	600	3	0 1 2	<0.01 <0.01 <0.01	A20503

Location, year, variety	Application					PHI	Deltamethrin	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
						3	≤0.01	
Langadas Macedonia, Greece 1997, Gedina (zucchini)	EG	13	1.6	800	4	0 3 7	<0.02 <0.02 ≤0.02	C002581
Langadas Macedonia, Greece 1998, Gedina (zucchini)	EG	13	1.3	1000	4	0 3	<0.02 <0.02	C005161
Cadriano Emilia Romagna, Italy 1997 Nostrana Tipo Bolognese (zucchini)	EG	13	4.2×2, 2.5×2	300×2 , 500×2	4	0 3 7	<0.02 <0.02 ≤0.02	C002581
Molfetta Puglia, Italy 1997 Cora (zucchini)	EG	13	2.5, 2.1×3	500, 600×3	4	0 3 7	<0.02 <0.02 ≤0.02	C002581
Andria Puglia, Italy 1998 Carosello Barese	EG	13	1.8	700	4	0 3	<0.02 ≤0.02	C005161
Brenes/Sevilla Andalucia Spain, 1997, Parker	EG	13	4.2	300	4	0 3 7	<0.02 <0.02 <0.02	C002581
Turis Valencia, Spain, 1998, Seneka (zucchini)	EG	13	2.5, 2.1×3	500, 600×3	4	0 3	<0.02 <0.02	C005161

Protected crop trials in Denmark, France, Germany, Greece, Italy, Spain and the UK were also with EC and EG formulations. Plot sizes in Germany in 1981 were 11 m^2 and 50 plants, and in Greece, Italy and Spain in 2000 10-30 m^2. The storage period was 1-2 months for the 1981 trials in Germany (method AL40/97) and 237-346 days for the 2000 trials (DGM F01-97-0). Control samples fortified with deltamethrin were extracted and analysed with the treated samples. Recoveries in 1981 from a sample fortified at 0.0025 mg/kg were 67%, and in 2000 from samples fortified at 0.02 mg/kg 73, 110 and 89%. Reports of the trials in Denmark in 1980, France in 1979 and Germany in 1978 were in summary form only.

Table 63. Residues of deltamethrin in cucumbers (indoor) after EG and EC foliar applications.

Location, year, variety	Application					PHI	Deltamethrin	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Las Norias-El Ejido Andalucia Spain, 2000, Trópico	EG	18	1.9, 1.8, 1.8	900, 950, 1000	3	0 1 3	0.016 0.015 0.012	C015571
Esovalta, Pella, Greece, 2000, 722	EG	18	1.17	1498	3	0 1 3	<0.01 0.01 <0.01	C015571
Molfetta Puglia, Italy 2000, locale di polignano	EG	18	1.8	1000	3	0 1 3	<0.01 <0.01 <0.01	C015571
Molfetta Puglia, Italy 2000, Sarig	EG	18	1.8	1000	3	0 1 3	<0.01 <0.01 <0.01	C015571
Kruemse, Germany, 1978, Pepinex (glasshouse)	EC	30	2.5	1200	3	0 1 2 3	0.04 0.06 0.03 0.04	A15295
Bonn, Germany, 1978, Sandra (glasshouse)	EC	30	2.5	1200	3	0 1 2 3	0.1 0.2 0.04 0.08	A15296
Lechhausen, Germany, 1978, Sandra (glasshouse)	EC	30	2.5	1200	3	0 1 2 3	0.05 0.05 0.03 0.03	A15297
Nackenheim, Germany,	EC	30	2.5	1200	3	0	0.02	A15298

Location, year, variety	Application					PHI	Deltamethrin	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
1978, Uniflora (glasshouse)						1 2 3	0.03 0.02 0.01	
Pezenas, France, 1979, Farbio (glasshouse)	EC	13	1.3	1000	1	2 4 7 14 2 4 7 14	0.009 0.004 <0.002 <0.002 0.04 (peel) 0.05 (peel) <0.002 (peel) <0.002 (peel)	
Pezenas, France, 1979, Farbio (glasshouse)	EC	13	1.3	1000	1	2 4 7 14 2 4 7 14	0.0045 0.002 <0.002 <0.002 0.026 (peel) 0.012 (peel) <0.002 (peel) <0.002 (peel)	
Colchester, UK, 1979, Sandra (glasshouse)	EC	18	1.8	1000	5	0	0.02	A20804
Terrington, UK, 1979, Farbiola (glasshouse)	EC	18	1.8	1000	3	0	0.09	A20805
Stalham, UK, 1979, Sandra (glasshouse)	EC	18	1.8	1000	3	0	0.02	A20806
Kruemse, Germany, 1981, Amplex (glasshouse)	EC	19	1.3	1500	4	0 1 2 3	0.08 0.02 0.02 0.03	A24849
Bonn, Germany, 1981, Sandra (glasshouse)	EC	19	1.3	1500	4	0 1 2 3	0.03 0.02 0.01 0.02	A24850
Bonn, Germany, 1981, Sandra (glasshouse)	EC	19	1.3	1500	4	0 1 2 3	0.03 0.01 0.03 0.02	A24851
Augburg, Germany, 1981, Bella (glasshouse)	EC	19-25	1.3	1500-2000	4	0 1 2 3	0.03 0.02 0.02 0.02	A24852
Marslev, Denmark, 1980, Evaden (glasshouse)	EC	38	1.3	3000	1	1 2 4 7	0.01 0.01 0.01 0.01	

Melons. In field trials in France, Greece, Italy and Spain EC and EG formulations were applied. Plot sizes in France in 1993 were 12-50 m^2 (12-60 plants) while those in France, Greece, Italy and Spain in 1997 and 1998 were 40-122 m^2. The storage period for samples was 3-4 months for the 1997 and 297-332 days for the 1998 trials. Control samples fortified with deltamethrin were extracted and analysed with the treated samples. A GC/ECD method was used in France in 1993 with recoveries from a sample fortified at 0.08 mg/kg of 101%, and in the 1997 and 1998 trials method DGM F01-97-0 was used with recoveries at 0.02 mg/kg of 114, 101, 146, 146, 128 and 111%. Two protected crop trials in France in 1978 were only reported in summary form.

Table 64. Residues of deltamethrin in melons after foliar applications of EC and EG formulations.

Location, year, variety	Application					PHI	Deltamethrin	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Fontès, France, 1978, Charantais (glasshouse)	EC	13	1.3	1000	2	2 2 2 4 4 4 7 7 7	0.009 whole 0.022 peel 0.002 pulp 0.009 whole 0.022 peel 0.002 pulp 0.006 whole 0.014 peel 0.002 pulp	A71654
Agde, France, 1978, Milford (glasshouse)	EC	13	1.3	1000	2	2 2 2 4 4 4 7 7 7	0.018 whole 0.04 peel <0.002 pulp 0.015whole 0.03 peel <0.002 pulp 0.004 whole 0.01 peel <0.002 pulp	A71654
Barie, Aquitaine, France, 1993, Diego	EC	13	6.3	200	4	3	≤0.02	A71660
Francescas, France, 1993, Jerac	EC	13	6.3	200	4	3	≤0.02	A71660
Collias, France, 1993, Diego	EC	13	6.3 6.3 4.2 4.2	200 200 300 300	4	3	≤0.02	A71660
Sallèles, France, 1993, Pantichito	EC	13	6.3	200	4	3	≤0.02	A71660
Vezieres Poitou-Charentes, France 1997, Dalton (musk melon)	EG	13	5	250	4	0 3 7 0 3 7	0.02 peel ≤0.02 peel <0.02 peel <0.02 pulp ≤0.02 pulp <0.02 pulp	A56781
St Avit Midi-Pyrénées, France, 1998, Buffalo (musk melon)	EG	13	4.2	300	4	0 3 7 0 3 7	<0.02 peel ≤0.02 peel <0.02 peel <0.02 pulp ≤0.02 pulp <0.02 pulp	C005490
Mesimeri Macedonia, Greece, 1997, Thrakiotika (musk melon)	EG	13	2.5	500	4	0 7 0 3 7	<0.02 peel ≤0.02 peel <0.02 pulp <0.02 pulp ≤0.02 pulp	A56781
Prohoma Macedonia, Greece, 1998, Daniel (musk melon)	EG	13, 13, 38, 13	2.5, 2.5, 7.5, 2.5	500	4	0 3 7 0 3 7	<0.02 peel <0.02 peel ≤0.02 peel <0.02 pulp <0.02 pulp ≤0.02 pulp	C005490
Prohoma Macedonia, Greece, 1998, Daniel (musk melon)	EG	13	2.5	500	4	0 3 7 0 3 7	<0.02 peel <0.02 peel ≤0.02 peel <0.02 pulp <0.02 pulp ≤0.02 pulp	C005490
Andria Puglia, Italy 1998, Galia (musk melon)	EG	13	2.1	600	4	0 3 7 0	0.02 peel <0.02 peel ≤0.02 peel <0.02 pulp	C005490

Location, year, variety	Application					PHI	Deltamethrin	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
						3	<0.02 pulp	
						7	<0.02 pulp	
Brenes/Sevilla Andalucia Spain, 1997, Almagro (musk melon)	EG	13	4.2	300	4	0	<0.02 peel	A56781
						3	<0.02 peel	
						7	<0.02 peel	
						0	<0.02 pulp	
						3	<0.02 pulp	
						7	<0.02 pulp	
Brenes/Sevilla Andalucia Spain, 1998, Castella (musk melon)	EG	13	4.2	300	4	0	<0.02 peel	C005490
						3	<0.02 peel	
						7	<0.02 peel	
						0	<0.02 pulp	
						3	<0.02 pulp	
						7	<0.02 pulp	
Brenes/Sevilla Andalucia Spain, 1998, Delada (musk melon)	EG	13	4.2	300	4	0	<0.02 peel	C005490
						3	<0.02 peel	
						7	<0.02 peel	
						0	<0.02 pulp	
						3	<0.02 pulp	
						7	<0.02 pulp	
Brenes/Sevilla Andalucia Spain, 1998, Daimiel (musk melon)	EG	13	4.2	300	4	0	<0.02 peel	C005490
						3	<0.02 peel	
						7	<0.02 peel	
						0	<0.02 pulp	
						3	<0.02 pulp	
						7	<0.02 pulp	

Mushrooms. In trials in Germany and France in mushroom growing chambers with plot sizes of 2.9-5 m^2 consisting of wooden beds 1.1-1.2×2.3-2.4 m for the German and plastic bags for the French trials EG formulations were applied 3 days before the first and second flushes. The interval between sampling and analysis was 10-11 months and the method was DGM F01/97-0 with recoveries from samples fortified at 0.02 mg/kg of 91, 106 and 125%.

Table 65. Residues of deltamethrin in mushrooms after application of an EG formulation.

Location, year, variety	Application				PHI	Deltamethrin	Report no.
	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Mutzig, France, 1998, 609	7.1, 7.9	0.71, 0.79	950, 1050	1	4[1]	<0.02	C008388
				2	0	<0.02	
				2	2	<0.02	
				2	3	<0.02	
				2	4	<0.02	
Mutzig, France, 1998, 609	7.5, 7.7	0.75, 0.77	1000, 1029	1	4[1]	0.03	C008388
				2	0	<0.02	
				2	2	<0.02	
				2	3	<0.02	
				2	4	<0.02	
Bühl, Germany, 1998, S112	7.7, 7.5	0.76, 0.75	1020, 1000	1	4[1]	<0.02	C008388
				2	0	<0.02	
				2	2	<0.02	
				2	3	<0.02	
				2	4	<0.02	
Bühl, Germany, 1998, S112	7.8, 7.5	0.78, 0.75	1034, 1000	1	4[1]	<0.02	C008388
				2	0	<0.02	
				2	2	<0.02	
				2	3	<0.02	
				2	4	<0.02	

[1]4 days after first application

Sweet corn. In field trials in Canada, France, Germany, Italy, New Zealand, Portugal, Spain and the UK an EC formulation was applied. Plot sizes for the trials in France in 1993 were 40 m^2 (storage period 9 months) and 30-100 m^2 in Germany in 1986, and in France, Germany, Italy Portugal and Spain in 2000 were 30-75 m^2 (storage period 253-355 days). Control samples fortified with deltamethrin were extracted and analysed with the treated samples. A GC/ECD method was used in the 1993 trials in France with a recovery of 84% from a sample fortified at 0.02 mg/kg, and method AL 40/79 in the 1986 trials in Germany with a recovery of 93% from a sample fortified at 0.003 mg/kg. In the trials in 2000 method DGM F01-97-0 was used with recoveries from cobs fortified at 0.02 mg/kg of 99, 96, 90 and 90%, from kernels at 0.02 mg/kg of 81, 93, 73 and 63% and from shoots at 0.02 mg/kg of 70, 79, 101 and 87%. The trials in Canada and New Zealand were reported in summary form only.

Table 66. Residues of deltamethrin in sweet corn after foliar applications of EC formulations.

Location, year, variety	Application				PHI	Deltamethrin	Report no.
	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Harrow, Ontario, Canada, 1982	13			1	0 0 1 1 3 3	0.015 cobs+husk <0.0012 cobs-husk 0.024 cobs + husk <0.0012 cobs-husk 0.042 cobs + husk <0.0012 cobs-husk	A71661 A71664
Harrow, Ontario, Canada, 1982	25			1	0 0 1 1 3 3	0.055 cobs+husk <0.0012 cobs-husk 0.084 cobs + husk <0.0012 cobs-husk 0.020 cobs + husk <0.0012 cobs-husk	A71661
Harrow, Ontario, Canada, 1982	13			1	0 1 3	<0.0025 cobs-husk <0.0025 cobs-husk <0.0025 cobs-husk	A71661
Harrow, Ontario, Canada, 1982	25			1	0 1 3	<0.0025 cobs-husk <0.0025 cobs-husk <0.0025 cobs-husk	A71661
Woodstock, Ontario, Canada, 1983	18			3	1	2.1 whole plant 0.26 cobs + husk 0.004 cobs-husk 0.008 kernels	A71663 A71661
Woodstock, Ontario, Canada, 1983	35			3	1	6.6 whole plant 0.71 cobs + husk 0.008 cobs-husk 0.0013 kernels	A71663
Louville la Chenard, Centre, France, 2000, Challenger F1	13	5	250	2	0 3 3	0.19 shoots ≤0.02 cobs <0.02 kernels	C016147
Amenucourt, Ile-de-France, France, 2000, Challenger F1	13	5	250	2	0 3 3	0.18 shoots ≤0.02 cobs <0.02 kernels	C016147
Captieux Aquitaine, France, 2000, 610	13	5	250	2	0 3 3	0.11 shoots ≤0.02 cobs <0.02 kernels	C014943
Hattersheim, Germany, 1986, Golden Super Sweet F1	13	3.1	400	1	0 3 7	<0.003 cobs ≤0.003 cobs <0.003 cobs	A71661 A36496
Ihringen, Germany, 1986, Aztek	13	3.1	400	1	0 3 7	<0.003 cobs ≤0.003 cobs <0.003 cobs	A71661 A36497
Neustadt, Germany, 1986, Golden Super Sweet	13	3.1	400	1	0 3 7	<0.003 cobs ≤0.003 cobs <0.003 cobs	A71661 A36498
Bornheim, Germany, 1986, Meritosa	13	3.1	400	1	0 3 7	<0.003 cobs ≤0.003 cobs <0.003 cobs	A71661 A36495

Location, year, variety	Application				PHI	Deltamethrin	Report no.
	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Kissing Bayern, Germany, 2000, RBS9299	13	4.2	300	2	0 3 3	0.29 shoots ≤0.02 cobs <0.02 kernels	C016147
Brandis Sachsen, Germany, 2000, Early Extra Sweet F1	13	4.2	300	2	0 3 3	0.33 shoots ≤0.02 cobs <0.02 kernels	C016147
Vechta-Langförden Niedersachsen, Germany, 2000, Sweet Wonder F1	13	4.2	300	2	0 3 3	0.15 shoots ≤0.02 cobs <0.02 kernels	C016147
Vaccolino Emilia-Romagna Italy, 2000, Dallas	13	2.1	600	2	0 3 3	0.30 shoots <0.02 cobs <0.02 kernels	C014943
Sala di Cesenatico Emilia-Romagna Italy, 2000, Dallas	13	1.3	1000	2	0 3 3	0.62 shoots <0.02 cobs <0.02 kernels	C014943
Whitford, New Zealand, 1980	13	6.7	186	1	0 1 3 7 10 16 16	0.26 plant 0.17 plant 0.24 plant 0.04 plant 0.09 plant <0.01 plant <0.01×4 grain	A71661
Salvaterra de Magos, Ribatejo e Oeste, Portugal, 2000, 770 A3000 11	13	1.1	1105	2	0 3 3	0.11 shoots <0.02 cobs <0.02 kernels	C014943
Langon, France, 1993, Rewar	20	10	200	4	3	<0.01 ears	A71667
Langon, France, 1993, Jubilée	20	10	200	4	3	<0.01 ears	A71667
Brenes/Sevilla Andalucia, Spain, 2000, Sheba-R	13	1.3	1000	2	0 3 3	0.06 shoots <0.02 cobs <0.02 kernels	C014943

Tomatoes. EC and EG formulations were applied in field trials in Australia, Finland, France, Germany, Greece, Italy, Mexico, New Zealand, South Africa, Spain and the UK. Plot sizes in Germany in 1980 (storage period 4 months) were 10-20 m^2 or 50 plants, and in France, Greece, Italy and Spain in 1996 and 1997 were 15-70 m^2 (storage period 4-8 months). Plot sizes in the UK trials were 0.1-0.25 hectares with storage periods of 3 months. Control samples fortified with deltamethrin were extracted and analysed with the treated samples. The methods used were RU-76.18.12/A (Spain 1977), AL40/97 (Germany 1980), RESID/96/10 (1996, recoveries 70, 98, 110, 97 and 96% from samples fortified at 0.02 mg/kg), DGM F01-97-0 (1997, recoveries at 0.02 mg/kg 82 and 87%). Method RU-78.11.07/A was used for the UK trials (recovery at 0.01 mg/kg 77%). The trials in Australia in 1981, Finland in 1979, France in 1992, Mexico in 1989, New Zealand in 1980 and South Africa in 1981 were reported in summary form only. It was not possible to determine whether the residues in the Mexico trials at the same PHI were from replicate analyses or plots.

In protected crop trials in Denmark, France, Germany, Greece, Italy, the Netherlands and Spain an EC formulation was applied to tomatoes. Plot sizes were 12-44 m^2 with sample storage for 228-373 days. Control samples fortified with deltamethrin were extracted and analysed with the treated samples. Method AGR/MOA/DEL-1 was used for the 2000 trials with recoveries at 0.01 mg/kg of 94, 85, 92, 102 and 88%.

Table 67. Residues of deltamethrin in tomatoes after foliar applications of EC and EG formulations.

Location, year, variety	Application					PHI (days)	Deltamethrin (mg/kg)	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.			
Field trials								
Cleveland, Australia, 1981, Calypso	EC	13	1.3	1000	5	1 3 7	<0.01 0.02 <0.01	A71610
Cleveland, Australia, 1981, Calypso	EC	25	2.5	1000	5	1 3 7	0.09 <0.01 <0.01	A71610
Finland, 1979, Katja	EC		1		1	1 3 6	0.04 0.03 0.01	A71610
Tarascon, France, 1977, Campbell	EC	10	1.3	800	3	2 5	0.009 0.009 c0.001	A71610
Beaucaire, France, 1977, Campbell	EC	10	1.3	800	3	2 5	0.01 0.007 c0.002	A71610 A20555
Puyicard, France, 1978, Heinz 706	EC	13	1.3	1000	2	0 2 5 7 7 7 7 9 12 14 14 14 14 21	0.019 0.016 0.014 0.008 0.003 concentrate <0.002 peeled 0.049 peel 0.008 0.006 0.004 0.002 concentrate <0.002 peeled 0.043 peel 0.004	A71610 A20557
Montfrin, France, 1983, Longue de Carina	EC	13	1.3	1000	1	0 1 3 5 7 14	0.025 0.02 0.02 0.02 0.01 <0.01	A71610 A71624
La Plume, France, 1992, 285	EC	5	2.5	200	1	7	<0.005	A71610
Boe, Aquataine, France, 1996, Perfect Peel	EG	13	2.5	500	4	0 3	<0.02 ≤0.02	A74164
Bonn, Germany, 1979, Schmidts Hellfrucht	EC	13	2.1	600	2	0 3 5 7	0.1 0.07 0.06 <0.02	A71610 A18775
Gersthofen, Germany, 1979, Hellfrucht	EC	13 19	2.1 3.1	600	2	0 3 5 7	0.7 0.04 0.04 <0.02	A71610 A18776
Hattersheim, Germany, 1979, Linda	EC	13	2.1	600	2	0 3 5 7	0.05 0.2 <0.02 <0.02	A71610 A18777
Hattersheim, Germany, 1980, Hofmanns Rentita	EC	13	2.1	600	3	0 1 2 3	<0.01 0.02 <0.01 0.03	A71610 A21100
Gersthofen, Germany, 1980, Hildares	EC	13	2.1	600	3	0 1 2 3	<0.01 <0.01 0.02 0.01	A71610 A21101

Location, year, variety	Application					PHI (days)	Deltamethrin (mg/kg)	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.			
Stelle, Germany, 1980, Haubtner	EC	13	2.1	600	3	0 1 2 3	0.07 0.06 0.05 0.01	A71610 A21102
Stelle, Germany, 1980, Haubtner	EC	13	2.1	600	3	0 1 2 3	0.01 0.02 0.01 ≤0.01	A71610 A21103
Korifi, Macedonia, Greece, 1996, Rio Grande	EG	13	2.5	500	4	0 3	<0.02 ≤0.02	A74164
Korifi, Macedonia, Greece, 1997, Rio Grande	EG	13	2.5	500	4	0 3 7	<0.02 ≤0.02 <0.02	C001247
Andria Puglia Italy, 1996, Sanga	EG	13	1.3	1000	4	0 3	<0.02 ≤0.02	A74164
Ostellato Emilia-Romagna, Itlay, 1997, Peto 1296	EG	13	2.5	500	4	0 3 7	<0.02 ≤0.02 <0.02	C001247
Stornarella Puglia, Italy, 1997, Hipeel 244	EG	13	2.1	600	4	0 3 7	<0.02 ≤0.02 <0.02	C001247
Los Mochis, Mexico, 1989, Red Cherry Large	EC	12	4.6	270	10	0 1 3	0.021, 0.025, <0.02 0.036, <0.02, <0.02 <0.02, 0.021, 0.024	A71610 corrected for recovery
Los Mochis, Mexico, 1989, Red Cherry Large	EC	25	9.2	270	10	0 1 3	0.028, 0.025, 0.069 0.041, 0.026, 0.028 0.092, 0.067, 0.066	A71610 corrected for recovery
New Zealand, 1980, Scoresby dwarf	EC	10	3	333	3	0 3 7 13 21 28	0.18 0.04 0.07 <0.01 <0.01 <0.01	A71610
New Zealand, 1980, Scoresby dwarf	EC	15	4.5	333	3	0 3 7 13 21 28	0.013 0.013 0.010 0.011 <0.01 <0.01	A71610
South Africa, 1981	EC		1.3		1	0 1 2 3 4 5	<0.05 <0.05 <0.05 <0.05 <0.05 <0.05	A71610
Nelspruit, South Africa, 1981	EC	13	1.3	1000	7	0 1 2 3 4 5 6 7	<0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05	A71610
Valencia, Spain, 1977, Valenciano tardio	EC	13	1.2	1100	1	1 3 6	<0.03 ≤0.03 <0.03	A71610 A20587
Brenes/Sevilla Andalucia, Spain, 1996, Trasan	EG	13	3.6	350	4	0 3	<0.02 <0.02	A74164
Brenes/Sevilla Andalucia, Spain, 1997, Trajan	EG	13	4.2	300	4	0 3 7	<0.02 <0.02 <0.02	C001247
Brenes/Sevilla	EG	13	4.2	300	4	0	<0.02	C001247

Location, year, variety	Application					PHI (days)	Deltamethrin (mg/kg)	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.			
Andalucia, Spain, 1997, Incas						3 7	<0.02 <0.02	
Newent, Gloss., UK, 1980	EC	18	175	10	1	0 3 7	<0.01 <0.01 <0.01	A71610
Romsey, Hants, UK, 1980, Pamela	EC	18	175	10	1	0 3 7	<0.01 0.01 0.02	A71610 A71615
Protected crops								
Rodovre, Denmark, 1980, Ida (glasshouse)	EC		1		1	1 3 5 7 14	0.03 0.03 0.03 0.02 0.02	A71610
Rodovre, Denmark, 1980, Ida (glasshouse)	EC		1		2	1 3 5 7 14	0.04 0.03 0.03 0.03 0.03	A71610
Arles, France, 1982, 63-5 (glasshouse)	EC	13	1.3	1000	1	7 13	<0.01 0.01	A71610 A71623
Elbsdorf, Germany, 1981, Luci (glasshouse)	EC	19	1.3	1500	4	0 1 2 3	0.1 0.2 0.2 0.2	A24902 A71610 A71618
Bonn, Germany, 1981, Sobeto (glasshouse)	EC	19	1.3	1500	4	0 1 2 3	0.08 0.2 0.1 0.08	A24903 A71610 A71618
Bonn, Germany, 1981, Sobeto (glasshouse)	EC	19	1.3	1500	4	0 1 2 3	0.06 0.1 0.1 0.2	A24904 A71610 A71618
Augsburg, Germany, 1981, Fruehstamm (glasshouse)	EC	19	1.3	1500	4	0 1 2 3	0.06 0.02 0.07 0.1	A24905 A71610
Esovalta, Macedonia, Greece, 2000, Alma	EC	13	1.2	1006	4	0 1 3	0.14 <0.01 0.01	C016111
Molfetta, Puglia, Italy, 2000, Naxos	EC	13	1.3	1000	4	0 1 3	0.02 0.05 0.03	C016111
Haren, Groningen, Netherlands, 2000, Aromata	EC	13	0.83	1500	4	0 1 3	0.02 0.02 <0.01	C016111
Haren, Groningen, Netherlands, 2000, Ferrari	EC	13	0.83	1500	4	0 1 3	0.02 0.02 0.01	C016111
Haren, Groningen, Netherlands, 2000, Aromata	EC	13	0.83	1500	4	0 1 3	0.01 0.015 0.01	C016111
Haren, Groningen, Netherlands, 2000, Ferrari	EC	13	0.83	1500	4	0 1 3	0.02 0.01 0.014	C016111
Los Palacios, Sevilla, Andalucia, Spain, 2000, Von	EC	13	0.83	1500	4	0 1 3	0.16 <0.01 <0.01	C016111

Location, year, variety	Application					PHI (days)	Deltamethrin (mg/kg)	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.			
Olhalvo, Ribatejo, Spain, 2000, Gama	EC	13	1.2	1010	4	0 1 3	0.03 0.02 0.013	C016111

Peppers. In field and protected crop trials in Canada and France EC and DP formulations were applied. Method RU-78.11.07/A was used in Canada. Details of the field trials in France were not reported. Protected crop trials were reported from France and the UK. Method RU-78.11.07/A was used in France in the 1979 trials with a recovery of 92% at 0.005 mg/kg.

Table 68. Residues of deltamethrin in peppers after foliar applications of EC formulations.

Location, year, variety	Application					PHI (days)	Deltamethrin (mg/kg)	Report no.
	Form	G ai/ha	g ai/hl	l/ha	No.			
Field trials								
Blennheim, Ontario, Canada, 1983	EC	18			3	1	0.002	A71610 A31662
Blennheim, Ontario, Canada, 1983	EC	35			3	1	0.002	A71610 A31662
Blennheim, Ontario, Canada, 1983	EC	18			3	1	0.007	A71610 A31662
Blennheim, Ontario, Canada, 1983	EC	18			3	1	0.002	A71610 A31662
Blennheim, Ontario, Canada, 1983	EC	18			3	1	0.002	A71610 A31662
Harrow, Ontario, Canada, 1983	EC	13			1	-	0.032, 0.022, 0.011	A71610 A31662
Harrow, Ontario, Canada, 1983	EC	25			1	-	0.027, 0.015, 0.0055	A71610 A31662
Protected crop								
Colchester, UK, 1979, Deltona (glasshouse)	EC	18	1.8	1000	1	0	0.07	A71610
Terrington, UK, 1979, Bellboy (glasshouse)	EC	18	1.8	1000	1	0	0.09	A71610

Egg plants (aubergines). Only summaries of field trials in France in 1978 were reported. An EC formulation was applied and residues were determined in the harvested and cooked egg plants.

Table 69. Residues of deltamethrin in aubergines (egg plants) after EC foliar applications.

Location, year, variety	Application				PHI (days)	Deltamethrin (mg/kg)	Report no.
	g ai/ha	g ai/hl	l/ha	No.			
Eyragues, France, 1978, Violette de Barbantane	5	1.3	400	1	3 3 5 5 7 7	0.025 0.015 cooked 0.010 0.005 cooked 0.006 0.005 cooked	A71610
Barbantane, France, 1978, Violette de Barbantane	13	1.3	400	1	0 1 3 5 7 14	<0.01 <0.01 <0.01 <0.01 <0.01 <0.01	A71610

Leafy vegetables

Curly kale. In field trials in Germany and the UK an EC formulation was applied. Plot sizes were 30-65 m^2. The storage period for samples was 6 months and 210-328 days for the 1998 trials in Germany. Control samples fortified with deltamethrin were extracted and analysed with the treated samples. In 1988 in Germany method AL40/97 was used with recoveries from a sample fortified at 0.01 mg/kg of 82%, and method DGM F01-97-0 with recoveries at 0.02 mg/kg of 105, 93, 122 and 111%.

Table 70. Residues of deltamethrin in curly kale after foliar applications of EC formulations.

Location, year, variety	Application				PHI	Deltamethrin	Report no.
	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Stelle, Germany, 1988, Mooskrauser	7.5	1.9	400	3	0 3 5 7	0.14 0.11 0.12 0.11	A41456
Bornheim, Germany, 1988, Darkibor	7.5	1.9	400	3	0 3 7	0.08 0.095 0.065	A41457
Germany, 1988, Niedriger grüner Krauser	7.5	1.9	400	3	0 3 5 7	0.16 0.10 0.095 0.095	A41458
Borheim, Nordrhein-Westfalen, Germany, 1998, Matrix	7.5	2.5	300	3	0 3 7	0.43 0.38 0.32	C005491
Weilerswist, Nordrhein-Westfalen, Germany, 1998, Wundergrün	7.5	2.5	300	3	0 3 7	0.43 0.50 0.34	C005491
Borheim-Brenig, Nordrhein-Westfalen, Germany, 1999, Venezia	7.5	2.5	300	3	0 7	0.59 0.39	C009198
Nörvenich-Rath, Nordrhein-Westfalen, Germany, 1999, Wunderland halbhoch	7.5	2.5	300	3	0 7	0.51 0.32	C009198
Shepperton, Surrey, UK, 1998, Winter Bore	7.5	2.5	300	3	0 4 7	0.21 0.10 0.08	C005491

Lettuce. In field trials in France and Spain an EG formulation was applied. Plot sizes were 20-60 m^2. In one of the 1994 trials in France lettuce was grown in a plastic tunnel open at each end and the storage period was 5-9 months. Control samples fortified with deltamethrin were extracted and analysed with the treated samples. In the 1998 trials in France a GC/ECD method was used with recoveries at 0.02 mg/kg of 93 and 100%, in 1994 method V/974/VEG/01/01 with recoveries at 0.05 mg/kg of 88, 84, 86, 84, 92, 100, 102, 110, 88, 88, 96 and 92%, and in 1995 method RESID/96/10 with recoveries at 0.05 mg/kg of 84, 66, 87 and 117%.

Table 71. Residues of deltamethrin in lettuce after EG foliar applications.

Location, year, variety	Application				PHI	Deltamethrin	Report no.
	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Bruges, Aquitaine, France, 1994, Carlane	13	2.5	200	3	0 1 3 7	0.45 0.44 0.29 0.14	C005443 A55221

Location, year, variety	Application				PHI	Deltamethrin	Report no.
	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Tarascon, Bouches du Rhône, France, 1994, Okta (plastic covered tunnel/greenhouse)	13	2.5	200	3	0 1 4 8	0.56 0.63 0.41 0.24	C005443 A55221
Bressols, Midi-Pyrénés, France, 1995, Nancy	13	2.1	600	3	0 3 5 8	0.21 0.18 0.14 <0.05	C005443 A56782
Bressols, Midi-Pyrénés, France, 1995, Batavia/Sierra	13	2.1	300	3	0 3 5 8	0.30 0.13 0.09 <0.05	C005443 A56782
Velleron, France, 1998, Atria	13	3.6	350	3	3	0.18, 0.07	C005549
Barbentane, France, 1998, Markant	13	4.2	300	3	3	0.26, 0.16	C005549
Bonreposi Mirambell, Valencia, Spain, 1994, Valladolid	13	4.2	300	3	0 1 3 6	0.22 0.26 0.15 0.05	C005443 A55221
Brenes, Andalucia, Spain, 1995, Valladolid	13	4.2	300	3	0 1 2 7	0.27 0.24 0.25 0.16	C005443 A55221
Brenes, Andalucia, Spain, 1995, Valladolid	13	4.2	300	3	0 3 5 7	0.20 0.12 0.08 <0.05	C005443 A56782
Trani, Spain, 1995, Salina	13	1.8	700	3	0 3 5 7	0.27 <0.05 0.07 <0.05	C005443 A56782

Spinach. In field trials in France, Germany and Italy EC and SC formulations were applied. Plot sizes for the trials in Germany were 7-100 m^2 (storage period 3-6 months). Control samples fortified with deltamethrin were extracted and analysed with the treated samples. Method AL40/97 was used in the trials in Germany with recoveries at 0.01 mg/kg of 77, 129 and 117%. Summary reports only were provided for trials in France in 1978 and 1979 and Italy in 1983.

Table 72. Residues of deltamethrin in spinach after EC and SC foliar applications.

Location, year, variety	Application					PHI	Deltamethrin	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Tarascon, France, 1978, F1 Impérial	EC	18	1.7	1030	1	2 4 8 4 8	0.48 0.33 0.22 0.27 cooked 0.21 cooked	A20624 A71710
Tarascon, France, 1978, F1 Paris	EC	18	1.7	1030	1	2 4 8 4 8	0.52 0.30 0.16 0.28 cooked 0.12 cooked	A71710
Tarascon, France, 1979, F1 Paris	EC	13	1.3	1000	1	2 4 7 14 7 14	0.4 0.2 0.14 0.12 0.12 cooked 0.10 cooked	A20626 A71710
Tarascon, France, 1979, F1 Paris	EC	13	1.3	1000	1	2 4	0.4 0.2	A71710

Location, year, variety	Application					PHI (days)	Deltamethrin (mg/kg)	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.			
						7 14 7 14	0.17 0.15 0.15 cooked 0.12 cooked	
Tarascon, France, 1979, F1 Impérial	EC	18	1.8	1000	1	2 4 7 2 4 7	0.18 0.22 0.35 0.16 cooked 0.20 cooked 0.28 cooked	A71710
Hattersheim, Germany, 1980, Matador	EC	13	2.1	600	3	0 3 5 7	0.3 0.7 0.2 0.09	A71710 A20420
Stelle, Germany, 1980, Monoppa	EC	13	2.1	600	3	0 3 5 7	0.7 0.3 0.3 0.1	A71710 A20423
Stelle, Germany, 1982, Monoppa	EC	13	2.1	600	3	0 3 5 7	0.4 0.2 <0.01 0.03	A71710 A25170
Bornheim, Germany, 1982, Matador	EC	13	2.1	600	3	0 3 5 7	0.6 0.2 0.1 0.09	A71710 A25171
Gersthofen, Germany, 1982, Matador	EC	13	2.1	600	3	0 3 5 7	0.5 0.1 0.06 0.04	A71710 A25172
Hattersheim, Germany, 1982, Wiremona	EC	13	2.1	600	3	0 3 5 7	0.5 0.2 0.2 0.03	A71710 A25173
Bornheim, Germany, 1982, Matador	SC	13	2.1	600	3	0 3 5 7	0.4 0.1 0.2 0.1	A71710 A25167
Gersthofen, Germany, 1982, Matador	SC	13	2.1	600	3	0 3 5 7	0.7 0.1 0.2 0.06	A71710 A25168
Hattersheim, Germany, 1982, Wiremona	SC	13	2.1	600	3	0 3 5 7	0.4 0.4 0.3 0.5	A71710 A25169
Stelle, Germany, 1982, Monnopa	SC	13	2.1	600	3	0 3 5 7	0.5 0.4 0.2 0.1	A71710 A25424
Bornheim, Germany, 1982, Matador	SC	13	2.1	600	3	0 3 5 7	0.06 0.2 0.2 0.2	A71710 A25425
Gersthofen, Germany, 1982, Matador	SC	13	2.1	600	3	0 3 5 7	0.6 0.2 0.4 0.08	A71710 A25426
Hattersheim, Germany, 1982, Wiremona	SC	13	2.1	600	3	0 3 5 7	0.3 0.6 0.7 1.0	A71710 A25427

Location, year, variety	Application					PHI (days)	Deltamethrin (mg/kg)	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.			
Stelle, Germany, 1982, Monnopa	SC	13	2.1	600	3	0 3 5 7	0.4 0.2 0.2 0.1	A71710 A25166
Cisterna, Italy, 1983, Seven R Hybrid	EC	7.5	1.3	600	1	0 1 3 5 7 14	0.44 0.33 0.22 0.07 0.02 <0.005	A71710
Cisterna, Italy, 1983, Seven R Hybrid	EC	15	25	600	1	0 1 3 5 7 14	0.81 0.62 0.46 0.26 0.10 0.018	A71710

Beans (unshelled). In field trials in France, Greece, Germany, Italy, Portugal and Spain EC, EG and SC formulations were applied. Plot sizes in Germany in 1979 and 1980 were 15-40 m^2 (storage period 3-9 months), and for the 1996 and 2000 trials 40-90 m^2 (145-262 days for the 1996 trials in Germany, Greece, Spain and Italy and 377-389 days for the trials in 2000). Control samples fortified with deltamethrin were extracted and analysed with the treated samples. Methods AL 2/77 and AL40/97 were used in Germany in 1979 and 1980, method RESID/96/10 in the 1996 trials with recoveries at 0.02 mg/kg of 74, 74, 80, 83 and 82% from seeds, 72% from pods, and 69, 790, 72, 68, 65, 73, 78 and 68% from hulls, and method AGR/MOA/DEL-1 in 2000 with recoveries from green pods fortified at 0.01 mg/kg of 87 and 80%. Reports of the French trials in 1978-1992 were summaries.

Table 73. Residues of deltamethrin in beans (unshelled) after EC, EG and SC foliar applications.

Location, year, variety	Application					PHI (days)	Deltamethrin (mg/kg)	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.			
Meyrargues, France, 1978, Super violet (French bean)	EC	13	1.3	1000	1	1 2 4 7 14 1 2 4 7 14	0.12 beans + pods 0.15 0.20 0.14 0.008 0.06 cooked 0.11 cooked 0.12 cooked 0.10 cooked 0.004 cooked	A71733 A71734
Hyères, France, 1978, Baraqué, (French bean)	EC	18	1.8	1000	1	1 2 3 4 6 7 1 2 3 4 6 7	0.001 0.001 0.001 <0.001 <0.001 0.001 0.002 after washing <0.001 <0.001 0.001 0.001 0.001	A71733
Hyères, France, 1979, Daisy, (French bean)	EC	13	1.0	1200	1	2 4 6 14 2 4	0.11 beans with pods 0.12 0.05 0.01 0.01 cooked	A71733 A20571

Location, year, variety	Application					PHI	Deltamethrin	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
						6 14	0.015 0.007 <0.005	
Hyères, France, 1979, Calvi, (French bean)	EC	13	1.0	1200	1	2 4 6 14 2 4 6 14	0.1 beans with pods 0.06 0.05 <0.005 0.06 cooked 0.05 0.04 <0.005	A71733 A20572
Hyères, France, 1979, Calvi, (French bean)	EC	15	1.3	1200	1	2 4 6 14 2 4 6 14	0.065 beans + pods 0.035 0.02 0.007 0.018 cooked 0.01 0.01 0.007	A71733 A71745
Hyères, France, 1979, Daisy, (French bean)	EC	15	1.3	1200	1	2 4 6 14 2 4 6 14	0.1 beans with pods 0.06 0.03 0.008 0.02 cooked 0.02 0.02 <0.005	A71733 A71743
Hyères, France, 1979, Calvi, (French bean)	DP	13			1	2 4 6 14 2 4 6 14	0.01 beans with pods 0.007 <0.005 <0.005 <0.005 cooked <0.005 <0.005 <0.005	A71733 A71749
Hyères, France, 1979, Daisy, (French bean)	DP	13			1	2 4 6 14 2 4 6 14	0.01 beans with pods <0.005 <0.005 <0.005 0.005 cooked <0.005 <0.005 <0.005	A71733 A71747
Meynes, France, 1982, Mangetout	EC	13	1.3	1000	1	7 14	0.05 whole bean 0.02 whole bean	A71733 A71751
Vivy, France, 1992, Morgan (French bean)	EC	7.5	3.8	200	1	8	0.007 whole bean	A71733 A71752
Dunes, Midi-Pyrénées, France, 1996, Flagrano (green bean)	EG	13	5.0	250	2	0 0 7 7	<0.02 seed 0.12, 0.11, 0.12 (0.12 av) hull <0.02 seed 0.04 (3) hull	A74187
Paray-Douaville, Ille de France, France, 1996, Vernel	EG	13	5.0	250	2	0 0 7 7	<0.02 seed 0.02 hull <0.02 seed 0.02 hull	A74188
Stelle, Germany, 1979, Bravo (French bean)	EC	13	2.1	600	1	0 3 5 7	0.02 whole pod <0.01 <0.01 <0.01	A71733 A18839
Stelle, Germany, 1979, Bravo (French bean)	EC	13	2.1	600	2	0 3	0.05 whole pod 0.01	A71733 A18840

Location, year, variety	Application					PHI	Deltamethrin	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
						5 7	<0.01 <0.01	
Bornheim, Germany, 1979, Morona (French bean)	EC	13	2.1	600	2	0 3 5 7	0.02 whole pod <0.01 <0.01 <0.01	A71733 A18841
Hattersheim, Germany, 1979, Prelude (French bean)	EC	13	2.1	600	1	0 3 5 7	0.02 whole pod 0.05 <0.01 <0.01	A71733 A18842
Hattersheim, Germany, 1980, St-Andreas (French bean)	EC	13	2.1	600	3	0 3 5 7	0.06 whole pod 0.02 <0.01 <0.01	A71733 A21387
Stelle, Germany, 1980, Maya (French bean)	EC	13	2.1	600	3	0 3 5 7	0.02 whole pod 0.01 0.02 <0.01	A71733 A21388
Bornheim, Germany, 1980, Morona (French bean)	EC	13	2.1	600	3	0 3 5 7	0.05 whole pod 0.03 0.02 0.01	A71733 A21389
Gersthofen, Germany, 1980, Sotexa (French bean)	EC	13	2.1	600	3	0 3 5 7	0.01 whole pod <0.01 <0.01 <0.01	A71733 A21390
Swisttal-Ollheim, Nordrhein-Westfalen, Germany, 1996, Borlotto Rosso	EG	13	3.1	400	2	0 0 7 7	<0.02 seed 0.05 hull <0.02 seed 0.02 hull	A74188
Bornheim, Nordrhein-Westfalen, Germany, 1996,Vivian v. Zwan	EG	13	3.1	400	2	0 0 7 7	<0.02 seed 0.06 hull <0.02 seed 0.02 hull	A74188
Nisi, Macedonia, Greece, 1996, Maestro (green bean)	EG	13	2.5	500	2	0 7	0.03 pod <0.02 pod	A74187
Bondeno, Emilia-Romagna, Italy, 1996, Giulia (green bean)	EG	13	2.5	500	2	0 0 7 7	<0.02 seed 0.03 hull <0.02 seed 0.03 hull	A74187
Bologna, Emila-Romagna, Italy 2000, Ferrari (kidney bean)	EC	13	4.2	300	2	0 7	0.01 green pods <0.01 green pods	C016472
Andria, Puglia, Italy, 2000, Pinto (kidney bean)	EC	13	1.6	800	2	0 7	0.08 green pods 0.01 green pods	C016472
Salvaterra de Magos Ribatejo e Oeste, Portugal, 2000, Garrafal (kidney bean)	EC	13	4.2	300	2	0 7	0.02 green pods <0.01 green pods	C016472
Brenes, Andalucia, Spain, 2000, Bush Blue Lake 274 (kidney bean)	EC	13	4.2	300	2	0 7	0.04 green pods 0.03 green pods	C016472
Brenes, Sevilla, Spain, 1996, Modus (green bean)	EG	13	4.2	300	2	0 0 7 7	<0.02 seed 0.02 hull <0.02 seed <0.02 hull	A74187

Beans (shelled). In field trials in France and Germany an EC formulation was applied. Plot sizes in Germany in 1979 were 15-40 m^2 with a storage period of 3-4 months. Method AL 2/77 was used to

analyse the samples. All the trials in France and the 1980 trials in Germany were reported only in summary form.

Table 74. Residues of deltamethrin in beans (shelled) after EC foliar applications.

Location, year, variety	Application				PHI (days)	Deltamethrin (mg/kg)	Report no.
	g ai/ha	g ai/hl	l/ha	No.			
Meynes, France, 1979, Agualduce	13	1.3	1000	1	2 4 7 14 2 4 7 14 2 4 7 14	<0.005 beans no pod <0.005 <0.005 <0.005 0.09 pods 0.14 0.02 0.07 0.04 beans + pods 0.07 0.01 0.03	A71759
Meynes, France, 1979, Agualduce	13	1.3	1000	1	2 4 7 14 2 4 7 14 2 4 7 14	<0.005 beans no pod <0.005 <0.005 <0.005 0.10 pods 0.02 0.01 0.03 0.05 beans + pods 0.01 0.005 0.01	A71759
Gouzangrez, France, 1980, Seville	13	1.3	1000	2	5 5	<0.005 beans 0.008 pods	A71759
Stelle, Germany, 1979, Con Amore	13	2.1	600	2	0 3 5 7	<0.01 beans no pods <0.01 <0.01 <0.01	A71759 A18534
Bornheim, Germany, 1979, Trio	13	2.1	600	2	0 3 5 7	<0.01 beans no pods <0.01 0.01 0.01	A71759 A18535
Gersthofen, Germany, 1979, Con Amore	13	2.1	600	2	0 3 5 7	0.01 beans no pods <0.01 <0.01 <0.01	A71759 A18536
Hattersheim, Germany, 1979, Dreifach Weisse	13	2.1	600	2	0 3 5 7	<0.01 beans no pods <0.01 <0.01 <0.01	A71759 A18537
Gersthofen, Germany, 1980, Con Amore	13	2.1	600	3	0 3 5 7	<0.01 beans no pods <0.01 <0.01 <0.01	A71759 A20408
Stelle, Germany, 1980, Con Amore	13	2.1	600	3	0 3 5 7	<0.01 beans no pods <0.01 <0.01 <0.01	A71759 A20409
Bornheim, Germany, 1980, Trio	13	2.1	600	3	0 3 5 7	<0.01 beans no pods <0.01 <0.01 <0.01	A71759 A20410

Location, year, variety	Application				PHI (days)	Deltamethrin (mg/kg)	Report no.
	g ai/ha	g ai/hl	l/ha	No.			
Hattersheim, Germany, 1980, Dreifach weisse	13	2.1	600	4	0 3 5 7	<0.01 beans no pods <0.01 <0.01 <0.01	A71759 A20411

Peas (unshelled). In field trials in France, Germany and the UK EC and EG formulations were applied. The plot sizes for the 1995 trials were 20-92 m^2 (storage period 10-12 months). Control samples fortified with deltamethrin were extracted and analysed with the treated samples. Method RU-78.11.07/A was used in France in 1979 (recovery 100% at 0.005 mg/kg) and method V/974/VEG/01/01 in 1995 with recoveries from pods fortified at 0.056 mg/kg of 91, 100, 86, 84, 88, 88, 98 and 88%, from hulls at 0.051 mg/kg of 76, 110, 96, 92, 105, 102, 91 and 88% and from seeds at 0.015 mg/kg of 93, 100, 80, 87, 87, 100, 93, 107, 113, 100, 93 and 73%. Reports for the trials in France in 1978 and 1979, and the UK in 1978 were only in summary form.

Table 75. Residues of deltamethrin in peas (unshelled) after EC and EG foliar applications.

Location, year, variety	Application					PHI (days)	Deltamethrin (mg/kg)	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.			
Beaucaire, France, 1978, Corne de Bellier	EC	13	1.3	1000	2	3 7 3 7	0.03 0.015 0.03 washed 0.005 washed	A71733
Jonquirères, France, 1979, Carouby (sugar peas)	EC	13	1.3	1000	1	2 4 7 14 2 4 7 14	0.10 whole 0.025 <0.005 <0.005 0.011 cooked <0.005 <0.005 <0.005	A71733 A20617
Jonquirères, France, 1979, Carouby	EC	13	1.3	1000	1	2 4 7 14 2 4 7 14	0.06 whole 0.015 0.025 <0.005 0.02 cooked 0.007 0.008 <0.005	A71733 A20616
Loigny la Bataille, Beauce, France, 1995, Piano	EG	13	4.2	300	3	0 0 0 7 7 7	0.06 pod 0.08 hull <0.015 seed 0.02 pod 0.06 hull <0.015 seed	A56787
Peronville, Beauce, France, 1995, Derier	EG	13	4.2	300	3	0 0 0 7 7 7	0.06 pod 0.10 hull <0.015 seed 0.02 pod 0.06 hull <0.015 seed	A56787
Swisttal-Ollheim Nordrhein-Westfalen, Germany, 1995, Progress No. 9	EG	13	4.2	300	3	0 0 0 7 7 7	0.02 pod 0.04 hull <0.015 seed <0.015 pod 0.02 hull <0.015 seed	A56787
Walesby, UK, 1978, Perfection	EC	13	1.3	1000	2	13	0.02	A71733
Dawesmere, East Anglia, UK, 1995,	EG	13	6.3	200	3	0 0	0.06 pod 0.07 hull	A56787

Location, year, variety	Application					PHI (days)	Deltamethrin (mg/kg)	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.			
Misty						0 7 7 7	<0.015 seed 0.02 pod 0.03 hull <0.015 seed	

Peas (shelled). In field trials in Germany in 1977 plot sizes were 15-50 m^2 and in 1980 20-40 m^2 (analytical method AL 2/77 in 1977 (recovery at 0.01 mg/kg 98%) and AL 40/79 in 1980). The sampling to analysis interval was approximately 4-5 months for 1977 and 12 months for 1980. Trials in France in 1978 were reported with only summary information.

Table 76. Residues of deltamethrin in peas (shelled) after EC foliar applications.

Location, year, variety	Application				PHI (days)	Deltamethrin (mg/kg)	Report no.
	g ai/ha	g ai/hl	l/ha	No.			
Beaucaire, France, 1978, Incol	13	1.3	1000	2	3 7 3 7 3 7	<0.002 seed <0.002 0.013 pods 0.01 0.008 whole 0.005 whole	A71759
Langenhain, Germany, 1977, Mingomark	13	2.1	600	2	0 3 5 7 14 0 3 5 7 14	<0.01 seed <0.01 <0.01 <0.01 <0.01 0.04 pods 0.03 0.04 0.04 0.04	A71759 A12241
Gersthofen, Germany, 1977, Salut	13	2.1	600	2	0 3 5 7 14 0 3 5 7 14	<0.01 seed <0.01 <0.01 <0.01 <0.01 0.05 pods 0.01 0.02 <0.01 <0.01	A71759 A12242
Hattersheim, Germany, 1977, Mingomark	13	2.1	600	2	0 3 5 7 14 0 3 5 7 14	<0.01 seed <0.01 <0.01 <0.01 <0.01 0.05 pods 0.02 0.03 0.05 0.04	A71759 A12243
Gersthofen, Germany, 1980, Sperlings Salout	5 13×2	0.83 2.1×2	600	3	0 3 5 7 7 7 7	0.7 plant 0.5 0.09 ≤0.01 whole <0.01 seed <0.01 pods 0.1 straw	A71759 A21557, A21558

Location, year, variety	Application				PHI (days)	Deltamethrin (mg/kg)	Report no.
	g ai/ha	g ai/hl	l/ha	No.			
Hattersheim, Germany, 1980, Mingo mark	5 13×2	0.83 2.1×2	600	3	0 3 5 7 0 3 5 7	<0.01 seed <0.01 <0.01 <0.01 0.05 pods 0.02 0.03 0.01	A71759 A21559, A21560
Stelle, Germany, 1980, Kleine Rheinländerin	5 13×2	0.83 2.1×2	600	3	0 3 5 7 7 7 7	0.1 plant 0.06 0.2 ≤0.01 whole <0.01 seed 0.4 pods 0.1 straw	A71759 A21561, A21562

Lupins. In field trials in Australia an EG formulation was applied. The plots were 40 m^2. The interval between sampling and analysis was 10 months. The analytical method used was based on "Residues in plant tissues", ref RU-78.11. 7/A. The recovery from a sample fortified at 0.2 mg/kg was 79%.

Table 77. Residues of deltamethrin in lupins after EG foliar applications in Australia in 1985.

Location, year, variety	Application					PHI (days)	Deltamethrin (mg/kg)	Report no.
		g ai/ha	g ai/hl	l/ha	No.			
Yarrawonga, Victoria, Uniharvest		13	15	84	2	12 26	<0.04 grain <0.04 grain	C019316
Yarrawonga, Victoria, Uniharvest		25	30	84	2	12 26	<0.04 grain <0.04 grain	C019316

Stored pulses. Trials were reported from Brazil, France and Hungary in which EC and DP formulations were applied to stored beans, chickpeas, lentils and peas. Control samples fortified with deltamethrin were extracted and analysed with the treated samples. The GC/ECD method for quantitative determination of deltamethrin residues in non-oily crops, RU-78.10.07/A, was used in the trials. The report for the 1988 trial in Hungary was in summary form only.

Table 78. Residues of deltamethrin in stored pulses after EC and DP applications.

Location, year, crop	Application				Storage (days)	Residue (mg/kg)	Report no.
	Form	g ai/tonne	g ai/hl	No.			
Rio de Janeiro, Brazil, 1982, Beans	DP	0.3		1	235	0.08	A71886 A72642
Rio de Janeiro, Brazil, 1982, Beans	DP	0.5		1	235	0.09	A71886 A72642
Rio de Janeiro, Brazil, 1982, Beans	DP	0.75		1	235	0.20	A71886 A72642
Rio de Janeiro, Brazil, 1982, Beans	EC	0.3		1	30 60 90 120 150 190	0.09 0.14 0.096 0.002 0.061 0.097	A71886 A71890
Rio de Janeiro, Brazil, 1982, Beans	EC	0.5		1	30 60 90 120 150 190	0.14 0.21 0.099 0.080 0.063 0.15	A71886 A71890
Rio de Janeiro,	EC	0.75		1	30	0.26	A71886

Location, year, crop	Application				Storage (days)	Residue (mg/kg)	Report no.
	Form	g ai/tonne	g ai/hl	No.			
Brazil, 1982, Beans					60 90 120 150 190	0.16 0.10 0.15 0.13 0.15	A71890
Saint Marcel, France, 1982, Chickpeas	EC	1.5		1	3 84 154 245 365 3 84 154 245 365 3 84 154 245 365	0.70 grain 0.65 0.65 0.80 0.45 0.02 cooked grain 0.03 0.02 0.01 0.04 <0.001 cooking water 0.005 <0.001 <0.001 <0.001	A71886 A71887
Saint Marcel, France, 1982, Haricots	EC	0.75		1	3 84 156 245 365 3 84 156 245 365 3 84 156 245 365	0.45 grain 0.40 0.42 0.40 0.25 0.05 cooked grain 0.08 0.02 0.06 0.015 0.015 cooking water 0.025 0.065 0.06 0.005	A71886 A71888
Saint Marcel, France, 1982, Haricots	EC	1.0		1	3 84 156 245 365 3 84 156 245 365 3 84 156 245 365	0.80 grain 0.85 0.75 0.50 0.40 0.05 cooked grain 0.05 0.1 0.03 0.06 0.01 cooking water 0.03 0.04 0.06 0.002	A71886
Saint Marcel, France, 1982, Peas	EC	1.0		1	3 84 156 245 365 3 84 156 245 365 3 84 156 245	0.70 grain 0.65 0.70 0.70 0.65 0.07 cooked grain 0.05 0.036 0.015 0.03 0.007 cooking water 0.01 0.007 <0.001	A71886 A71889

Location, year, crop	Application				Storage (days)	Residue (mg/kg)	Report no.
	Form	g ai/tonne	g ai/hl	No.			
					365	0.001	
Saint Marcel, France, 1982, Lentils	EC	1.0		1	3 84 154 245 365 3 84 154 245 365 3 84 154 245 365	0.60 grain 0.60 0.60 0.50 0.40 0.10 cooked grain 0.06 0.06 0.06 0.02 0.002 cooking water 0.003 0.003 0.002 <0.001	A71886 A71891
Tolna, Hungary, 1988, Peas	EC	0.25		1	0 5 10 20 35 55 75 96 114 136	0.18 0.25 0.20 0.18 0.19 0.16 0.17 0.18 0.17 0.17	A71886

Root and tuber crops

Beets. Field trials in Belgium, France and Germany were only reported in summary form.

Table 79. Residues of deltamethrin in beets after EC foliar applications.

Location, year, variety	Application				PHI (days)	Deltamethrin (mg/kg)	Report no.
	g ai/ha	g ai/hl	l/ha	No.			
Vlezembeek, Belgium, 1982, Diana (sugar beet)	10	2.5	400	2	140	<0.01 roots <0.01 leaves	A71585
Terminiers, France, 1992, Laser (sugar beet)	7.5	3.8	200	1	109	0.01 roots <0.005 leaves + neck	A71585
Avion, France, 1992, Laser (sugar beet)	7.5	3.8	200	1	131	<0.005 roots+leaves	A71585
Gonesse, France, 1992, Carat (sugar beet)	7.5	3.8	200	1	102	<0.005 roots+leaves	A71585
Vetheuil, France, 1992, Argos (sugar beet)	7.5	3.8	200	2	90	<0.005 roots	A71585
Gonesse, France, 1992, Carat (sugar beet)	7.5	3.8	200	4	102	<0.005 root+leaves	A71585
Cantin, France, 1992, Orix (sugar beet)	7.5	3.8	200	3	131	<0.005 roots+leaves	A71585
Pasly, France, 1994, Lorette (beetroot)	13	6.3	200	2	14	<0.02 roots	A71585
Mont de Bonneuil, France, 1994, Warrior (beetroot)	13	6.3	200	2	14	<0.02 roots	A71585
Vetheuil, France, 1994, Rouge globe Lora (beetroot)	13	6.3	200	2	14	<0.02 roots	A71585
Cléry-Saint-André, France, 1994, Crapaudine (beetroot)	13	6.3	200	2	14	<0.02 roots	A71585

Location, year, variety	Application				PHI	Deltamethrin	Report no.
	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Scharmbeck, Germany, 1978, Kawemono (sugar beet)	25	4.2	600	3	12 56 109 12 56 109	<0.02 roots <0.02 <0.02 0.2 0.1 0.09	A71585 A15991
Bonn, Germany, 1978, Kawemono (sugar beet)	25	4.2	600	3	9 36 9 36	<0.02 roots <0.02 0.3 0.06	A71585 A15993
Gersthofen, Germany, 1978, Kawemono (sugar beet)	25	4.2	600	3	19 29 37 19 29 37	<0.02 roots <0.02 <0.02 0.08 0.2 0.07	A71585 A15995
Hattersheim, Germany, 1978, Kawemono (sugar beet)	25	4.2	600	4	34 55 66 34 55 66	<0.02 roots <0.02 <0.02 0.02 0.2 0.03	A71585 A15997
Klecken, Germany, 1981, Primahill (sugar beet)	7.3	1.2	600	4	0 43 70 86 95 0 43 70 86 95	<0.005 roots <0.005 <0.005 <0.005 <0.005 0.2 leaves 0.007 <0.005 <0.005 <0.005	A71585 A25140
Ashausen, Germany, 1981, Kawemono (sugar beet)	7.3	1.2	600	4	0 43 70 86 95 0 43 70 86 95	<0.005 roots <0.005 <0.005 <0.005 <0.005 0.2 leaves 0.006 <0.005 <0.005 <0.005	A71585 A25141
Bornheim, Germany, 1981, Kawemono (sugar beet)	7.3	1.2	600	4	0 26 56 84 97 0 26 56 84 97	<0.01 roots <0.01 <0.01 0.01 0.02 0.08 leaves 0.1 <0.005 <0.005 <0.005	A71585 A25142
Hattersheim, Germany, 1981, Kawemono (sugar beet)	7.3	1.2	600	4	0 28 70 105 118 0 28 70 105 118	<0.01 roots <0.01 <0.01 <0.01 <0.01 0.3 leaves <0.01 <0.01 <0.01 <0.01	A71585 A25143

Location, year, variety	Application				PHI	Deltamethrin	Report no.
	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Brunstorf, Germany, 1982, Primahill (sugar beet)	7.5	1.3	600	4	0 28 55 88 0 28 55 88	<0.005 roots <0.005 <0.005 <0.005 0.2 leaves 0.006 <0.005 <0.005	A71585 A25159
Bornheim, Germany, 1982, Kawemono (sugar beet)	7.5	1.3	600	4	0 28 54 81 0 28 54 81	<0.01 roots <0.01 <0.01 <0.01 0.4 leaves 0.02 <0.01 <0.01	A71585 A25160
Hattersheim, Germany, 1982, Kawemono (sugar beet)	7.5	1.3	600	4	0 28 0 28	<0.01 roots <0.01 0.1 leaves 0.02	A71585 A25161
Stelle, Germany, 1988, Kawemaya (sugar beet)	7.5	1.9	400	2	0 19 47 145 19 47 145	0.13 plants <0.01 roots <0.01 <0.01 <0.01 leaves <0.01 <0.01	A71585 A43603
Bornheim, Germany, 1988, Eva (sugar beet)	7.5	1.9	400	2	0 34 75 149 34 75 149	0.26 plants <0.01 roots <0.01 <0.01 <0.01 leaves <0.01 <0.01	A71585 A43604
Kelsterbach, Germany, 1988, Tina (sugar beet)	7.5	1.9	400	2	0 34 75 34 75	0.50 plants <0.01 root <0.01 <0.01 leaves <0.01	A71585 A43605
Gersthofen, Germany, 1989, Kaveduka (sugar beet)	7.5	1.9	400	2	0 16 30 120 16 30 120	0.35 plants <0.01 roots <0.01 <0.01 <0.01 leaves <0.01 <0.01	A71585 A45982
Stelle, Germany, 1989, Kawemaya (sugar beet)	7.5	1.9	400	2	0 17 59 125 17 59 125	0.37 plants <0.01 roots <0.01 <0.01 <0.01 leaves <0.01 <0.01	A71585 A45981

Carrots. In field trials in France, Germany, Greece, Italy, Portugal and the UK EC and EG formulations were applied. In Germany plot sizes were 15-40 m^2 (method AL 40/79, storage period for samples 2-3 months) in 1980 and 20-45 m^2 (method AGR/MOA/DEL-1, storage period 124-255 days) in 2000. Control samples fortified with deltamethrin were extracted and analysed with the treated samples. Recoveries from samples fortified at 0.01 mg/kg were 70, 71, 97, 70, 100, 71, 70, 80, 79 and 76%. Reports for trials in France in 1979 and 1993 and Germany in 1979 and 1981 were in summary form only.

Table 80. Residues of deltamethrin in carrots after EC and EG foliar applications.

Location, year, variety	Application					PHI (days)	Deltamethrin (mg/kg)	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.			
Comps, France, 1979, Nantaise	EC	13	1.3	1000	1	2 4 7	0.008 0.008 0.005	A71585
Comps, France, 1979, Lido	EC	13	1.3	1000	1	2 4 7	0.015 0.008 0.007	A71585
Meynes, France, 1993, Gnanko	EC	7.5	3.8	200	2	7	<0.01	A71585
Meynes, France, 1993, Cantoro	EC	7.5	3.8	200	2	7	<0.01	A71585
Saulx les Chartreux, Ile de France, France, 2000, Tino	EG	13, 11, 13	5, 5, 5	250, 222, 250	3	0 7	<0.01 <0.01	C016078
St Sylvestre sur lot, Aquitaine, France, 2000, Junior	EG	13	5	250	3	0 7	<0.01 <0.01	C016257
Stelle, Germany, 1979, Nantaise	EC	13	2.1	600	2	0 3 5 7	<0.02 <0.02 <0.02 <0.02	A71585 A18778
Bornheim, Germany, 1979, Nantaise	EC	13	2.1	600	2	0 3 5 7	<0.02 <0.02 <0.02 <0.02	A71585 A18779
Langenhain, Germany, 1979, Gonsenheimer treib	EC	13	2.1	600	2	0 3 5 7	<0.02 <0.02 <0.02 <0.02	A71585 A18780
Gersthofen, Germany, 1979, Karotan	EC	13	2.1	600	2	0 3 5 7	<0.02 <0.02 <0.02 <0.02	A71585 A18781
Hattersheim, Germany, 1979, Lange rote Stumpfe	EC	13	2.1	600	2	0 3 5 7	<0.02 <0.02 <0.02 <0.02	A71585 A18782
Gersthofen, Germany, 1980, Kieler Rote	EC	13	2.1	600	3	0 3 5 7	<0.02 <0.02 0.02 0.02	A71585 A20488
Bornheim, Germany, 1980, Nantaise	EC	13	2.1	600	3	0 3 5 7	<0.02 0.02 <0.02 <0.02	A71585 A20489
Stelle, Germany, 1980, Nantaise	EC	13	2.1	600	3	0 3 5 7	0.1 <0.02 <0.02 <0.02	A71585 A20490
Hattersheim, Germany, 1980, Nantaise	EC	13	2.1	600	3	0 3 5 7	0.2 0.07 <0.02 <0.02	A71585 A20491
Stelle, Germany, 1981, Frueh Bund	EC	7.3-8.6	1.2-1.4	600	3	0 3 5 7	<0.005 <0.005 <0.005 <0.005	A71585 A25147
Kruemse, Germany, 1981, Frueh Bund	EC	7.3	1.2	600	3	0 3 5 7	<0.005 <0.005 <0.005 <0.005	A71585 A25148

Location, year, variety	Application					PHI (days)	Deltamethrin (mg/kg)	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.			
Comps, France, 1979, Nantaise	EC	13	1.3	1000	1	2 4 7	0.008 0.008 0.005	A71585
Bornheim, Germany, 1981, Nantaise	EC	7.3	1.2	600	3	0 3 5 7	<0.005 <0.005 <0.005 <0.005	A71585 A25149
Hattersheim, Germany, 1981, Gonsenheimer treib	EC	7.3	1.2	600	3	0 3 5 7	<0.005 <0.005 <0.005 <0.005	A71585 A25150
Gundelfingen, Bayern, Germany, 2000, Merida	EG	13	4.2	300	3	0 2 4 7	<0.01 <0.01 <0.01 <u>≤0.01</u>	C016078
Bornheim, Nordrhein-Westfalen, Germany, 2000, Nerak	EG	13	4.2	300	3	0 2 4 7	<0.01 <0.01 <0.01 <u>≤0.01</u>	C016078
Liebertwolkwitz, Sachsen, Germany, 2000, Lange Rote Stumpfe	EG	13	4.2	300	3	0 2 4 7	<0.01 <0.01 <0.01 <u>≤0.01</u>	C016078
Thessaloniki, Macedonia, Greece, 2000, Nirvana	EG	13	2.5	500	3	0 7	<0.01 <0.01	C016257
Monticelli-Ferrara, Emilia-Romagna, Italy, 2000, Nevis	EG	13	2.5	500	3	0 7	<0.01 <0.01	C016257
Zapponeta, Puglia, Italy, 2000, Bolero	EG	13	2.5	500	3	0 7	<0.01 <0.01	C016257
Salvaterra de Magos Ribatejo e Oeste, Portugal, 2000, Nantes	EG	13	4.2	300	3	0 7	<0.01 <0.01	C016257
Cambridge, Cambridgeshire, UK, 2000, Nairobi	EG	13	4.2	250	3	0 2 4 7	<0.01 <0.01 <0.01 <u>≤0.01</u>	C016078

<u>Parsnips</u>. Field trials in the UK in 1978 were reported in summary form.

Table 81. Residues of deltamethrin in parsnips after EC foliar applications, UK, 1978.

Location, variety	Application				PHI (days)	Deltamethrin (mg/kg)	Report no.
	g ai/ha	g ai/hl	l/ha	No.			
Briningham, All American	13	2.1	600	1	76	<0.01	A71585

<u>Chicory</u>. In field trials in France and Germany with an EG formulation plot sizes were 37-50 m^2. Storage periods from harvest to analysis were 5-6 months. The analytical method DGM F01/97-0 was used with recoveries from roots fortified at 0.02 mg/kg of 80 and 66% and from shoots at 0.02 mg/kg of 79 and 89%.

Table 82. Residues of deltamethrin in chicory after EG foliar applications.

Location, year, variety	Application				PHI	Deltamethrin	Report no.
	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Fleury, Picardie, France, 1997, Bea	13	5	250	3	0 0 14 14	<0.02 root 0.48 shoot <0.02 root 0.15 shoot	C001246
Rémérangles, Picardie, France, 1997, Turbo	13	5	250	3	0 0 13 13	<0.02 root 0.61 shoot <0.02 root 0.18 shoot	C001246
Gelsdorf, Nordrhein-Westfalen, Germany, 1997, Focus	13	4.2	300	3	0 0 14 14	<0.02 root 0.5 shoot <0.02 root 0.21 shoot	C001246
Fuchshain, Sachsen, Germany, 1997, Monitor	13	4.2	300	3	0 0 15 15	<0.02 root 0.25 shoot <0.02 root 0.11 shoot	C001246

Potatoes. In field trials in France, Germany, Greece, Portugal and Spain EC and EG formulations were applied. Plot sizes were 33-103 m^2 in Germany in 1991 (storage period 190-218 days) and 34-56 m^2 in all the countries in 1995, 1998 and 2000 (storage 5-6 months for 1995, 280-358 days for 1998 and 326-333 days for 2000). Control samples fortified with deltamethrin were extracted and analysed with the treated samples. A GC/ECD method was used in the 1991 trials (recovery 89% at 0.01 mg/kg, the lowest fortification), and method RESID 96/10 (recovery 70% at 0.025 mg/kg) in Germany in 1995. In 1998 method DGM F01/97-0 (reported recoveries 138 and 145% at 0.02 mg/kg) was used, and in 2000 method AGR/MOA/DEL-1 (recovery 101% at 0.01 mg/kg).

Table 83. Residues of deltamethrin in potatoes after EC and EG foliar applications.

Location, year, variety	Application					PHI	Deltamethrin	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Boissay, Centre, France, 1995, Bintje	EG	7.5	2.5	300	4	0 14	<0.02 <0.02	A56789
Stelle, Germany, 1991, Roxy	EC	7.5	2.5	300	5	0 3 7 14 28	<0.01 <0.01 <u>≤0.01</u> <0.01 <0.01	A52611
Bornheim, Nordrhein-Westfalen, Germany, 1991, Sieglinde	EC	7.5	2.5	300	5	0 3 7 14 29	<0.01 <0.01 <u>≤0.01</u> <0.01 <0.01	A52611
Gersthofen, Bayern, Germany, 1991, Agria	EC	7.5	2.5	300	5	0 3 7 14 28	<0.01 <0.01 <u>≤0.01</u> <0.01 <0.01	A52611
Hesen, Germany, 1991, Clivia	EC	7.5	2.5	300	5	0 3 7 14 28	<0.01 <0.01 <u>≤0.01</u> <0.01 <0.01	A52611
Gersthofen, Bayern, Germany, 1995, Ponto	EG	7.5	2.5	300	4	0 13	<0.02 <0.02	A56789
Dahlen, Sachsen, Germany, 1995, Aula	EG	7.5	2.5	300	4	0 14	<0.02 <0.02	A56789
Goumenissa, Macedonia, Greece, 1998, Spuda	EG	13	4.2	300	4	0 3	<0.02 <0.02	C004453

Location, year, variety	Application					PHI	Deltamethrin	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
						7	<0.02	
Drepano, Kozani, Greece, 2000, Spuda	EC	13	2.5	500	4	0 7	<0.01 <0.01	C015284
Salvaterra de Magos Ribatejo e Oeste, Portugal, 1998, Kenbeck	EG	13	4.2	300	4	0 3 7	<0.02 <0.02 <0.02	C004453
Caldas da Rainha, Ribatejo e Oeste, Portugal, 1998, Kenbeck	EG	13	4.2	300	4	0 3 7	<0.02 <0.02 <0.02	C004453
Salvaterra de Magos, Lisboa, Portugal, 2000, Mona Lisa	EC	13	4.2	300	4	0 7	<0.01 <0.01	C015284
Carpesa, Valencia, Spain, 1998, Score	EG	13	4.2	300	4	0 3 7	<0.02 <0.02 <0.02	C004453

Sweet potato. A single field trial in South Africa was reported in summary form.

Table 84. Residues of deltamethrin in sweet potatoes after an EC foliar application in South Africa.

Location, year, variety	Application					PHI	Deltamethrin	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Johannesburg, 1981	EC	63			10	4 8 14 4 8 14 21	<0.05 tubers <0.05 <0.05 0.43-0.51 vines 0.44-0.49 0.46-0.51 0.20-0.24	A71585

Radishes. In field trials in France (1992) and Germany (1978-1985) an EC formulation was applied. Plot sizes in 1978 and 1980 were 5-40 m^2 (storage period for samples 3-7 months). Control samples fortified with deltamethrin were extracted and analysed with the treated samples. Method AL2/77 was used in the 1978 trials with a recovery of 100% reported for a sample fortified at 0.005 mg/kg, and method AL 40/79 in 1980. The trials in 1992 in France and 1982 and 1985 in Germany were reported in summary form only.

Table 85. Residues of deltamethrin in radish after foliar applications.

Location, year, variety	Application					PHI	Deltamethrin	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
St Florent le Jeune, France, 1992, Bamba	EC	7.5			1	7	<0.005	A71585
Stelle. Harburg, Germany, 1978, Saxa	EC	13	2.1	600	2	0 3 5 7	<0.005 <0.005 <0.005 <0.005	A15488
Bonn, Germnay, 1978, Cherry Belle	EC	13	2.1	600	2	0 3 5 8	<0.005 <0.005 <0.005 <0.005	A15489
Gersthofen, Germany, 1978, Neckarperle	EC	13	2.1	600	2	0 3 6 7	<0.005 <0.005 <0.005 <0.005	A15490

Location, year, variety	Application					PHI (days)	Deltamethrin (mg/kg)	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.			
Hattersheim, Germany, 1978, Stoplite	EC	13	2.1	600	2	0 2 5 7	<0.005 <0.005 <0.005 <0.005	A15491
Stelle, Harburg, Germany, 1980, Saxa	EC	13	2.1	600	3	0 3 5 7	<0.02 <0.02 <0.02 <0.02	A20496
Bornheim, Germany, 1980, Cherry Belle	EC	13	2.1	600	3	0 3 5 7	<0.02 <0.02 <0.02 <0.02	A20497
Gersthofen, Germany, 1980, Neckarperle	EC	13	2.1	600	2	0 3 5 7	<0.02 <0.02 <0.02 <0.02	A20498
Hattersheim, Germany, 1980, Saxa	EC	13	2.1	600	3	0 3 5 7	<0.02 <0.02 <0.02 <0.02	A20499
Hattersheim, Germany, 1982, Sperlings parat	EC	7.5	1.3	600	3	0 3 5 7	<0.01 <0.01 <0.01 <0.01	A71585 A25637
Langenhain, Germany, 1982, Sperlings parat	EC	7.5	1.3	600	3	0 3 5 7	<0.01 <0.01 <0.01 <0.01	A71585 A25638
Bornheim, Germany, 1982, Cherry Belle	EC	7.5	1.3	600	3	0 3 5 7	<0.01 <0.01 <0.01 <0.01	A71585 A25639
Stelle, Germany, 1982, Rota	EC	7.5	1.3	600	3	0 3 5 7	0.007 0.01 <0.01 <0.01	A71585 A25640
Hattersheim, Germany, 1985, Sora	EC	12	1.2	1000	1	28 42 28 42	<0.01 bulbs <0.01 <0.01 leaves <0.01	A71585 A34935

Artichokes. In field trials in France, Germany, Greece, Italy and Spain an EG formulation was applied. Plot sizes were 30-57 m^2. The storage period for samples was 4-11 months. Control samples fortified with deltamethrin were extracted and analysed with the treated samples. Method RESID/96/10 was used with recoveries of 69% at 0.02 mg/kg, and 72, 73, 84, 70, 73 and 74% at 0.05 mg/kg.

Table 86. Residues of deltamethrin in artichokes after EG foliar applications.

Location, year, variety	Application				PHI (days)	Deltamethrin (mg/kg)	Report no.
	g ai/ha	g ai/hl	l/ha	No.			
Cantillana, Andalucia, Spain, 1995, Blanco de Tudela	13	1.4	900	4	0 3	0.09 <0.05	A56780
Stornara, Puglia, Italy, 1995, Violetto di Provenza	13	1.3	1000	4	0 3	<0.05 <0.05	A56780
Trinitapoli, Puglia, Italy, 1995, Violetto di Provenza	13	1.3	1000	4	0 3	0.06 <0.05	A56780
Brenes/Sevilla, Andalucia, Spain, 1996, Blanco de Tudela	13	1.4	900	4	0 3	0.03 0.02	A74152

Location, year, variety	Application				PHI	Deltamethrin	Report no.
	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Macau, Aquitaine, France, 1996, Camus de Macau	13	2.5	500	4	0 3	0.07 0.03	A74152
Barzan Poitou-Charentes, France, 1996, Camus de Macau	13	2.5	500	4	0 3	0.04 0.04	A74152
Pyrgela-Argous Peleponnes, Greece, 1996, Iria	13	2.1	600	4	0 3	<0.02 <0.02	A74152
Stonara, Puglia, Italy, 1996, Violetto di Provenza	13	1.3	1000	4	0 3	0.02 <0.02	A74152

Tree nuts

Hazelnuts. In field trials in France, Italy and Spain EC and EG formulations were applied to trees by knapsack sprayer and mistblower. Plot sizes were 75-112 m^2. The storage period for samples was 277-314 days. Control samples fortified with deltamethrin were extracted and analysed with the treated samples. Method DGM F01/97-0 was used and recoveries of 63 and 75% reported for samples fortified at 0.02 mg/kg.

Table 87. Residues of deltamethrin in hazelnut (filbert) kernels after EG and EC applications.

Location, year, variety	Application					PHI	Deltamethrin	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Auros, Aquitaine, France, 1999, Insis	EG	13	2.5	500	3	0 28	<0.02 <0.02	C009201
Serino, Campania, Italy, 2000, Tonda di Giffoni	EC	13	1.3	966	3	0 31	<0.02 <0.02	C014846
Reus, Cataluña, Spain, 1999, Negreta	EG	13	1.3	1000	3	0 30	<0.02 <0.02	C009201
Riudoms, Cataluña, Spain, 1999, Pauetet	EG	13	1.3	1000	3	0 30	<0.02 <0.02	C009201
Reus, Cataluña, Spain, 2000, Negret	EC	13	1.3	1000	3	0 31	<0.02 <0.02	C014846

Walnuts. In field trials in France, Italy and Germany EC and EG formulations were applied to trees by knapsack sprayer and mistblower. Plot sizes were 48-264 m^2 with a minimum of 3 trees/plot. The storage period for samples was 237-295 days. Control samples fortified with deltamethrin were extracted and analysed with the treated samples. A GC/ECD method was used in the 1994 trials in France with a recovery of 89% at 0.02 mg/kg, and method DGM F01/97-0 in the 1999 trials with recoveries of 58, 68 and 93% from samples fortified at 0.02 mg/kg.

Table 88. Residues of deltamethrin in walnuts after EC and EG applications.

Location, year, variety	Application					PHI	Deltamethrin	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Monclar, Aquitaine, France, 1994, Lara	EC	38[1] 13 13 13	4.2 2.1 2.1 2.1	600	4	14	≤0.02 edible part	A70667
Castest en Dorthe, France, 1994, Franquette	EC	13 38[1] 13 13	1.3 3.8 1.3 1.3	1000	4	14	≤0.02 edible part	A70667
Geisenheim, Hessen, Germany, 1999, Nr 1247	EG	13	1.3	1000	3	0 30	<0.02 kernel <0.02 kernel	C009200
Meckenheim-Altendorf, Nordrhein-Westfalen, Germany, 1999, Geisenheimer Nr 26	EG	13	0.83	1500	3	0 30	<0.02 kernel <0.02 kernel	C009200
Giffoni Valle Piana,	EG	13	1.4	900	3	0	<0.02 kernel	C009201

Location, year, variety	Application					PHI (days)	Deltamethrin (mg/kg)	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.			
Campania, Italy, 1999, Noce di Sorrento						29	<0.02 kernel	
Giffoni Valle Piana, Campania, Italy, 1999, Noce di Sorrento	EG	13	1.4	900	3	0 29	<0.02 kernel <0.02 kernel	C009201

[1] 62.5 g/l WG formulation used at 0.05 kg/ha in place of a 25 g/l EC formulation at 0.05 kg/ha for these sprays resulting in higher application rates.

Oilseeds

Rape. EC, EG and SC formulations were applied in field trials in France (1979 and 1995) and Germany (1977-1995). Plot sizes in Germany in 1982, 1988, 1989 and 1995 and France in 1995 were 34-100 m^2. The storage period for samples was 3-15 months. Control samples fortified with deltamethrin were extracted and analysed with the treated samples. Method AL40/79 was used in Germany in the 1982, 1988 and 1989 (EC) trials with a recovery of 89% reported for a sample fortified at 0.01 mg/kg, method L 6/86 in the 1989 (SC) trials and method V/974/OIL/01/01 in 1995 (recoveries from plant samples fortified at 0.022 mg/kg were 105, 105, 105, 109, 91, 100, 95 and 109%, from plants without pods at 0.022 mg/kg 109 and 86%, from pods at 0.081 mg/kg 86, 93, 94 and 104%, from straw at 0.081 mg/kg 86, 148, 142, 158, 83 and 90% and from seeds at 0.073 mg/kg 90, 89, 93 and 96%. The trials in France in 1979 and in Germany in 1977 and 1979 were reported in summary form only.

Table 89. Residues of deltamethrin in rape after EC, EG and SC applications.

Location, year, variety	Application					PHI (days)	Deltamethrin (mg/kg)	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.			
Beynes, France, 1979, Jet neuf	EC	5	1	500	1	60	<0.01	A71790
Coulanges, France, 1979, Jet neuf	EC	5	1	500	1	48	<0.01	A71790
Amenucourt, Ile de France, France, 1995, Falcon	EG	7.5	3.8	200	4	0 7 15 22 22 58 58	0.07 shoot 0.04 shoot 0.03 shoot 0.03 shoot no pod <0.08 pod 0.09 straw <0.07 seed	A55220
Brecy, Picardie, France, 1995, Bristol	EG	7.5	3.8	200	4	0 8 15 28 28 66 66	0.037 shoot <0.02 shoot <0.02 shoot <0.02 shoot no pod <0.08 pod <0.08 straw <0.07 seed	A55220
Gersthofen, Germany, 1977, Komet	EC	13	2.1	600	1	73	<0.01 grain <0.01 cake <0.05 oil	A71790 A12402
Butlinger, Germany, 1977, Petranova	EC	13	2.1	600	1	51 80 51 80	0.01 grain 0.03 grain <0.01 cake <0.05 oil	A71790 A12406
Hattersheim, Germany, 1977, Kosa	EC	13	3.1	400	2	0 14 28 46	0.3 plants <0.02 plants <0.02 plants 0.07 grain	A71790 A19027
Bimohlen, Germany, 1979, Kosa	EC	13	3.1	400	2	0 16 29 37	0.3 plants 0.1 plants 0.05 plants 0.03 pods	A71790 A19028

Location, year, variety	Application					PHI	Deltamethrin	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
						51	0.04 grain	
Butling, Germany, 1979, Petranova	EC	13	3.1	400	2	0 19 31 35 36	0.05 plants 0.05 plants 0.03 plants <0.02 pods 0.05 grain	A71790 A19029
Gersthofen, Germany, 1979, Komet	EC	13	3.1	400	2	0 13 30 43	0.6 plants 0.1 plants <0.02 plants 0.05 grain	A71790 A19030
Elbstorf, Germany, 1982, Korina	EC	7.5	1.3	600	2	0 47 62 74	0.1 plants <0.03 plants <0.03 plants <0.005 grain	A71790 A25203
Bornheim, Germany, 1982, Quinta	EC	7.5	1.3	600	2	0 27 49 82	0.06 plants <0.03 plants <0.03 plants <0.005 grain	A71790 A25204
Gersthofen, Germany, 1982, Elvira	EC	7.5	1.3	600	2	0 31 47 60 60	0.3 plants <0.03 plants <0.03 plants <0.005 grain <0.05 straw	A71790 A25205
Frankfurt, Germany, 1982, Elvira	EC	7.5	1.3	600	2	0 25 53 79 79	0.03 plants 0.05 plants <0.03 plants 0.005 grain 0.05 straw	A71790 A25206
Elbstorf, Germany, 1982, Korina	EC	7.5	1.3	600	2	0 47 62 74	0.1 plant 0.02 plant 0.01 plants <0.01 seed	A25199 A71790
Bornheim, Germany, 1982, Quinta	EC	7.5	1.3	600	2	0 27 49 82	0.04 plant 0.02 plant 0.01 plants <0.01 seed	A25200 A71790
Gersthofen, Germany, 1982, Elvira	EC	7.5	1.3	600	2	0 31 47 60 60	0.3 plant 0.01 plant <0.01 plants <0.01 seed <0.05 straw	A25201 A71790
Frankfurt, Germany, 1982, Elvira	EC	7.5	1.3	600	2	0 25 53 79 79	0.02 plant <0.01 plant <0.01 plants <0.01 seed 0.07 straw	A25202 A71790
Harburg, Germany, 1988, Ceres	EC	7.5	1.9	400	3	0 7 14 28 56 78	0.25 plant 0.02 plant 0.03 plant <0.01 plant <0.05 seed <0.05 seed	A40716 A71790
Bornheim, Germany, 1988, Quinta	EC	7.5	1.9	400	3	0 7 14 28 56 80	0.16 plant 0.05 plant 0.01 plant <0.01 plant <0.05 seed <0.05 seed	A40717 A71790
Gersthofen, Germany, 1988, Lirabon	EC	7.5	1.9	400	3	0 7 15 31 56 56	0.14 plant 0.05 plant 0.05 plant <0.01 plant <0.05 seed <0.05 pods	A40718 A71790

Location, year, variety	Application					PHI	Deltamethrin	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
						73	<0.05 seed	
Winsenhoopte, Germany, 1989, Ceres	SC	7.5	1.9	400	4	0 14 26 56 73	0.24 plant 0.05 plant 0.04 plant <0.01 pods <0.01 seed	A46840 A71790
Bornheim, Germany, 1989, Quinta	SC	7.5	1.9	400	4	0 14 28 56 84	0.56 plant 0.08 plant 0.04 plant <0.01 pods <0.01 seed	A46841 A71790
Gersthofen, Germany, 1989, Ceres	SC	7.5	1.9	400	4	0 14 27 56 75	0.17 plant 0.06 plant 0.03 plant <0.01 pods <0.01 seed	A46842 A71790
Hattersheim, Germany, 1989, Lirabon	SC	7.5	1.9	400	4	0 14 28 56	0.25 plant 0.09 plant 0.01 plant <0.01 seed	A46843 A71790
Bornheim, Germany, 1989, Quinta	EC	7.5	1.9	400	4	0 14 28 84	0.24 plant 0.06 plant 0.02 plant <0.01 seed	A45548 A71790
Niedergruenden, Germany, 1989, Arabella	EC	7.5	1.9	400	4	0 14 30 56 75	0.1 plant 0.02 plant <0.01 plants <0.01 pods <0.01 seed	A45550 A71790
Gersthofen, Germany, 1989, Ceres	EC	7.5	1.9	400	4	0 14 27 56 75	0.09 plant 0.07 plant 0.06 plants <0.01 pods <0.01 seed	A45549 A71790
Stelle, Germany, 1989, Ceres	EC	7.5	1.9	400	4	0 14 26 56 73	0.19 plant 0.04 plant 0.01 plants <0.01 pods <0.01 seed	A45547 A71790
Barum-Horburg, Niedersachsen, Germany, 1995, Bristol	EG	7.5	2.5	300	4	0 7 13 28 28	0.09 shoot 0.04 shoot 0.036 shoot 0.024 shoot no pod <0.08 pod	A55220
Schwanheim, Hessen, Germany, 1995, Ceres	EG	7.5	3.8	200	4	0 7 12 26 26 42 42	0.10 shoot 0.038 shoot 0.056 shoot <0.02 shoot no pod <0.08 pod <0.08 straw <0.07 seed	A55220

Sunflower. In field trials in Canada, France, Greece, Germany, Italy and Spain EC and EG formulations were applied. Plot sizes in 1998 and 2000 were 45-80 m^2. The storage period for samples was 271-397 days. Control samples fortified with deltamethrin were extracted and analysed with the treated samples. Method DGM F01/97-0 was used in the 1998 trials (recoveries from flower/seed heads fortified at 0.05 mg/kg 99, 87, 113 and 117% and from seed at 0.05 mg/kg 96 and 89%), and method AGR/MOA/DEL-1 in the 2000 trials (recoveries from flower/seed heads at 0.01 mg/kg of 81, 98 and 91% and from seed at 0.01 mg/kg 95, 82 and 92%). The trials in Canada in 1980 and 1981, and in France in 1990 were reported in summary form only.

Table 90. Residues of deltamethrin in sunflowers after EC and EG applications.

Location, year, variety	Application					PHI (days)	Deltamethrin (mg/kg)	Ref.
	Form	g ai/ha	g ai/hl	l/ha	No.			
Morris, Canada, 1981	EC	5	15	34	1	75	<0.001	A71790
Morris, Canada, 1981	EC	4	12	34	1	75	<0.001	A71790
Winkler, Canada, 1980	EC	10	4.5	220	1	70	0.013	A71790
Winkler, Canada, 1980	EC	20	9.1	220	1	70	0.024	A71790
Winkler, Canada, 1980	EC	20	9.1	220	1	70	0.030	A71790
Winkler, Canada, 1980	EC	40	18	220	1	70	0.049	A71790
Winkler, Canada, 1980	EC	10	4.5	220	1	70	0.0015	A71790
Winkler, Canada, 1980	EC	20	9.1	220	1	70	0.0027	A71790
St Amboix, France, 1990, Vidoc	EC	7.5	2.5	300	1	84	<0.01	A71790
St Amboix, France, 1990, Vidoc	EC	15	5.0	300	1	84	0.012	A71790
Beaugency, France, 1990, Vidoc	EC	7.5	2.5	300	1	78	<0.005	A71790
Beaugency, France, 1990, Vidoc	EC	15	5.0	300	1	78	<0.005	A71790
Meung sur Loire, France, 1990, Frankasol	EC	7.5	2.5	300	1	80	<0.005	A71790
Meung sur Loire, France, 1990, Frankasol	EC	15	5.0	300	1	80	<0.005	A71790
Vouille Poitou-Charentes, France, 1998, Lucile	EG	7.5	2.5	300	3	0 10 21 39 59	0.07 inflorescence <0.05 inflorescence <0.05 inflorescence <0.05 inflorescence <u>≤0.05</u> seed	C004594
Braslou, Pays de la Loire, France, 2000, Prodisol	EC	7.5	3	250	3	0 57	0.04 flower heads <u>≤0.01</u> seed	C016321
Neustadt-Mußbach, Rheinland-Pfalz, Germany, 2000, Eurosol	EC	7.5	1.3	600	3	0 60	0.05 flower heads <u>≤0.01</u> seed	C016321
Biburg, Bayern, Germany, 2000, Flavia	EC	7.5	2.5	300	3	0 64	0.06 flower heads <u>≤0.01</u> seed	C016321
Horigi, Macedonia, Greece, 1998, Solarium	EG	7.5	1.3	600	3	0 10 20 41 62	0.07 inflorescence <0.05 inflorescence <0.05 inflorescence <0.05 inflorescence <u>≤0.05</u> seed	C004594
Bondeno, Emilia-Romagna, Italy, 1998, Kristal	EG	7.5	0.94	800	3	0 10 20 41 62	0.31 inflorescence <0.05 inflorescence <0.05 inflorescence <0.05 inflorescence <u>≤0.05</u> seed	C004594
Alcala de Guadaira, Andalucia, Spain, 1998, Turbo	EG	7.5	2.5	300	3	0 9 21 39 60	0.05 inflorescence <0.05 inflorescence <0.05 inflorescence <0.05 inflorescence <u>≤0.05</u> seed	C004594

<u>Soya beans</u>. Field trials in Australia, France, Côte d'Ivoire and Mexico were reported in summary form only.

Table 91. Residues of deltamethrin in soya beans after EC applications.

Location, year, variety	Application				PHI (days)	Deltamethrin (mg/kg)	Ref.
	g ai/ha	g ai/hl	l/ha	No.			
Caroona, Australia, 1981, Bragg	13			2	7 14	0.01 <0.01	A71790
Caroona, Australia, 1981, Bragg	25			2	7	<0.01	A71790

Location, year, variety	Application				PHI	Deltamethrin	Ref.
	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
					14	<0.01	
Arles, France, 1977, Amsoy G4	13	2.1	600	1	9	<0.002	A71790
Arles, France, 1977, Amsoy G4	13	2.1	600	1	14	<0.002	A71790
Arles, France, 1977, Amsoy G4	13	2.1	600	1	21	<0.002	A71790
Arles, France, 1977, Amsoy G4	13	2.1	600	2	7	<0.002	A71790
Arles, France, 1977, Amsoy G4	13	2.1	600	1	7	<0.002	A71790
Arles, France, 1977, Amsoy G4	13	2.1	600	1	30	<0.002 seed <0.002 pods	A71790
Arles, France, 1977, Amsoy G4	13	2.1	600	2	16	<0.002 seed 0.35 pods	A71790
Arles, France, 1977, Amsoy G4	13	2.1	600	1	16	<0.002 seed <0.002 pods	A71790
Arles, France, 1977, Amsoy G4	18	2.9	600	1	9	<0.002 seed <0.002 pods	A71790
Arles, France, 1977, Amsoy G4	18	2.9	600	1	14	<0.002	A71790
Arles, France, 1977, Amsoy G4	18	2.9	600	1	21	<0.002	A71790
Arles, France, 1977, Amsoy G4	18	2.9	600	2	7	<0.002	A71790
Arles, France, 1977, Amsoy G4	18	2.9	600	1	7	<0.002	A71790
Arles, France, 1977, Amsoy G4	18	2.9	600	1	30	<0.002 seed 0.32 pods	A71790
Arles, France, 1977, Amsoy G4	18	2.9	600	2	16	<0.002 seed <0.002 pods	A71790
Arles, France, 1977, Amsoy G4	18	2.9	600	1	16	<0.002 seed 0.32 pods	A71790
Arles, France, 1978, Ansoy 71	13	2.1	600	2	21	<0.005 seed 0.13 stem	A71790
Bouaké, Côte d'Ivoire, 1978, Berthoua	25	6.3	400	7	14	<0.001	A71790
Valle de Apatzingan, Mexico, 1980, Cajeme	13			2	16	<0.002 (3) seed <0.02 (3) oil <0.002 (3) cake	A71790
Valle de Apatzingan, Mexico, 1980, Cajeme	25			2	16	0.003 <0.002 0.01 seed 0.03, 0.02, 0.10 oil <0.002 (3) cake	A71790
Valle de Apatzingan, Mexico, 1980, Cajeme	13			2	16	<0.002 (3) seed <0.02 (3) oil <0.002 (3) cake	A71790
Valle de Apatzingan, Mexico, 1980, Cajeme	25			2	16	<0.002 (2) 0.003 seed <0.02 (2), 0.03 oil <0.002 (3) cake	A71790
Valle de Apatzingan, Mexico, 1980, Cajeme	13			2	16	<0.002 (3) seed <0.02 (3) oil <0.002 (3) cake	A71790
Valle de Apatzingan, Mexico, 1980, Cajeme	25			2	16	<0.002 (3) seed <0.02 (2), 0.03 oil <0.002 (3) cake	A71790
Valle de Apatzingan, Mexico, 1980, Cajeme	13			2	16	<0.002 (3) seed <0.02 (3) oil <0.002 (3) cake	A71790
Valle de Apatzingan, Mexico, 1980, Cajeme	25			2	16	<0.002 (3) seed <0.02 (3) oil <0.002 (3) cake	A71790
Valle de Apatzingan, Mexico, 1980, Cajeme	13			2	16	<0.002 (3) seed <0.02 (3) oil <0.002 (3) cake	A71790
Valle de Apatzingan, Mexico, 1980, Cajeme	25			2	16	<0.002 (3) seed <0.02 (3) oil <0.002 (3) cake	A71790
Valle de Apatzingan, Mexico, 1980, Cajeme	13			2	16	<0.002 (3) seed <0.02 (3) oil <0.002 (3) cake	A71790
Valle de Apatzingan, Mexico, 1980, Cajeme	25			2	16	<0.002 (2) 0.004 seed <0.02 (2), 0.04 oil	A71790

Location, year, variety	Application				PHI	Deltamethrin	Ref.
	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
						<0.002 (3) cake	
Valle de Apatzingan, Mexico, 1980, Cajeme	13			2	16	<0.002 (3) seed <0.02 (3) oil <0.002 (3) cake	A71790
Valle de Apatzingan, Mexico, 1980, Cajeme	25			2	16	<0.002 0.003 0.004 seed <0.02, 0.03, 0.04 oil <0.002 (3) cake	A71790
Valle de Apatzingan, Mexico, 1980, Cajeme	13			2	16	<0.002 (3) seed <0.02 (3) oil <0.002 (3) cake	A71790
Valle de Apatzingan, Mexico, 1980, Cajeme	25			2	16	<0.002 (2) 0.008 seed <0.02 (2), 0.08 oil <0.002 (3) cake	A71790
Valle de Apatzingan, Mexico, 1980, Cajeme	13			2	16	<0.002 (3) seed <0.02 (3) oil <0.002 (3) cake	A71790
Valle de Apatzingan, Mexico, 1980, Cajeme	25			2	16	<0.002 (2) 0.033 seed <0.02 (2), 0.33 oil <0.002 (3) cake	A71790
Valle de Apatzingan, Mexico, 1980, Cajeme	13			2	16	<0.002 (3) seed <0.02 (3) oil <0.002 (3) cake	A71790
Valle de Apatzingan, Mexico, 1980, Cajeme	25			2	16	<0.002 (3) seed <0.02 (3) oil <0.002 (3) cake	A71790

Cotton seed. Field trials in India, Côte d'Ivoire, Mexico, Morocco and the USA were reported in summary form only.

Table 92. Residues of deltamethrin in cotton seed after EC applications.

Location, year, variety	Application				PHI	Deltamethrin	Report no.
	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Coimbatore, India, 1979, Suvin	10	0.83-1.3	800-1200	8	24	<0.01 (3) seed <0.01 (3) fibre <0.01 (3) oil <0.01 (3) cake	A71790
Coimbatore, India, 1979, Suvin	20	1.7-2.5	800-1200	8	24	<0.01 (3) seed <0.01 (3) fibre <0.01 (3) oil <0.01 (3) cake	A71790
Coimbatore, India, 1979, MCU5	15	2.5-5	300-600	6	24	<0.01 (3) seed <0.01 (3) fibre	A71790
Tamil Nadu, India, 1981, MCU9	15	1.9-2.5	800-1200	6	16	<0.002 (3) seed	A71790
Bouaké, Côte d'Ivoire, 1978, T120-7	15	10	150	6	12	0.007 fibre	A71790
Hermosillo, Mexico, 1980, Deltapine 80	13			4	10	<0.01 (2)	A71790
Hermosillo, Mexico, 1980, Deltapine 80	25			4	10	<0.01 (2)	A71790
Hermosillo, Mexico, 1980, Deltapine 80	13			4	0 2 4 7 14	<0.01 (2) <0.01 (2) <0.01 (2) <0.01 (2) <0.01 (2)	A71790
Hermosillo, Mexico, 1980, Deltapine 80	25			4	0 2 4 7 14	<0.01 (2) <0.01 (2) <0.01 (2) <0.01 (2) <0.01 (2)	A71790

Location, year, variety	Application				PHI (days)	Deltamethrin (mg/kg)	Report no.
	g ai/ha	g ai/hl	l/ha	No.			
Tadla, Morocco, 1978, Puma 67	13	83	15	7	28	<0.002 (2)	A71790
Stoneville, Mississippi, USA, 1976, Stoneville 231	23			4	45	<0.02 ginned seed	A71790
Texas, 1976, Stoneville 231	23			5	49	<0.02 ginned seed	A71790
Shreveport, Louisiana, USA, 1976, DPL125	23			5	43	<0.02 ginned seed	A71790
Florence, South Carolina, USA, 1976, Coker 310	23			14	52	<0.01 ginned seed	A71790
Jamesville, North Carolina, USA, 1976, McNair	23			8	27	<0.01 ginned seed	A71790
Mercedes, Texas, USA, 1976, Stoneville 231	23			3	11	<0.01 ginned seed	A71790
Bard, California, USA, 1976, DPL16	23			7	77	<0.01 ginned seed	A71790
Marion, Arkansas, USA, 1977, DPL 213	23			15	25	<0.02 ginned seed <0.005 delinted seed <0.05 linters <0.005 hulls <0.005 solv ext meal <0.02 refined oil <0.005 alk soapstock	A71790
Weslasco, USA, 1977, Stoneville 213	23			5	22	<0.005 ginned seed	A71790
Weslasco, USA, 1977, Stoneville 213	23			6	14	<0.005 ginned seed	A71790
Grand Junction, Tenessee, USA, 1977, Hancock	23			7	30	<0.02 ginned seed	A71790
Fiars Point, Mississippi, USA, 1977	23			8	42	0.03 ginned seed	A71790
Burleson County, Texas, USA, 1977, Stoneville 213	23			8	22	<0.005 ginned seed	A71790
Foreman, Arizona, USA, 1977, Stoneville 213	23			10	40	<0.02 ginned seed	A71790
Shreveport, Louisiana, USA, 1977, La Glanless	23			14	28	0.08 ginned seed	A71790
Bard, California, USA, 1977, DPL-61	23			15	14	<0.02 ginned seed	A71790
Kerman, USA, 1977, Aeala SJ2	23			15	14	<0.02 ginned seed	A71790
Maricopa, Arizona, USA, 1977, DP-16	23			15	14	<0.02 ginned seed	A71790
Florence, California, USA, 1977, Coker 310	23			15	15	<0.02 ginned seed	A71790
Marion, Arkansas, USA, 1977, DPL-213	23			15	25	<0.005 ginned seed	A71790

Cereals

Wheat. In field trials in France, Germany and the UK EC and EG formulations were applied. Plot sizes in 1995 were 50-92 m^2. The storage period for samples was 12-14 months. Control samples fortified with deltamethrin were extracted and analysed with the treated samples. A GC-MS method was used in 1995 and recoveries from grain fortified at 0.02 mg/kg were 115, 110, 105 and 115%. The trials in France in 1978, 1979, 1992 and unspecified year(s) and in Germany in 1979 were reported in summary form only.

Table 93. Residues of deltamethrin in wheat after applications of various EC and EG formulations.

Location, year, variety		Application				PHI	Deltamethrin	Report no.
	Form	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Nérac, France, 19xx, Top	EC	10	2	500	1	53	0.003 grain	A71908
Nérac, France, 19xx, Top	EC	18	3.5	500	1	53	0.003 grain	A71908
Issé, France, 19xx, Champlein	EC	10	2	500	1	53	0.004 grain	A71908
Issé, France, 19xx, Champlein	EC	18	3.5	500	1	53	0.0035 grain	A71908
Le Sel de Bretagne, France 1978, Capitole	EC	7.5	1.5	500	1	80	0.002 grain 0.015 straw	A71908
Le Sel de Bretagne, France 1978, Capitole	EC	15	3	500	1	80	0.04 grain 0.05 straw	A71908
Coulommiers, France 1978, Capitole	EC	7.5	1.5	500	1	74	0.001 grain 0.025 straw	A71908
Coulommiers, France 1978, Capitole	EC	15	3	500	1	74	0.025 grain 0.025 straw	A71908
Chateau Thierry, France 1979, Joss	EC	7.5	1.5	500	1	61	0.0015 grain 0.025 straw	A71908
Chateau Thierry, France 1979, Joss	EC	15	3	500	1	61	0.002 grain 0.025 straw	A71908
Courville sur Eure, France 1979, Hardi	EC	7.5	1.5	500	1	64	<0.001 grain <0.001 straw	A71908
Courville sur Eure, France 1979, Hardi	EC	15	3	500	1	64	<0.001 grain <0.001 straw	A71908
Oppy, France 1992, Apollo	EC	5	2.5	200	1	36	<0.002 grain <0.010 straw	A71908
Dancourt-Popincourt, France 1992	EC	5	2.5	200	1	55	<0.002 grain 0.035 straw	A71908
Cabourg, France 1992	EC	5	2.5	200	1	42	<0.002 grain 0.045 straw	A71908
Montchauvet, France 1992	EC	5	2.5	200	1	51	<0.002 grain 0.015 straw	A71908
Antoigne, France 1992	EC	5	2.5	200	1	25	<0.005 grain 0.055 straw	A71908
Bucy le Roi, Centre, France, 1995, Recital	EG	6.3, 7.5	2.1, 2.5	300, 300	2	0 27 27	0.15 ear <u>≤0.02</u> grain <u>0.39</u> straw	A56788
Hattersheim, Germany, 1979, Janus	EC	13	2.1	600	1	0 14 21 28 28	0.2 plant 0.03 ears 0.01 ears <0.01 grain 0.1 straw	A18843 A71908
Klecken, Germany, 1979, Herakles	EC	13	2.1	600	1	0 14 21 28 39 39	0.2 plant 0.05 ears 0.01 ears 0.02 ears 0.02 grain 0.06 straw	A18844 A71908
Gersthofen, Germany, 1979, Kolibri	EC	13	2.1	600	1	0 13 22 30 30	1.0 plant 0.1 ears 0.1 ears 0.02 grain 0.2 straw	A18897 A71908
Bornheim, Germany, 1979, Janus	EC	13	2.1	600	1	0 14 21 28 28	0.2 plant 0.05 ears <0.01 ears 0.02 grain 0.1 straw	A18898 A71908
Bad Camberg-Erbach, Hessen, Germany, 1995, Rektor	EG	6.3, 7.5	2.1, 2.5	300, 300	2	0 30 30	0.14 ear <u>≤0.02</u> grain <u>0.09</u> straw	A56788

Location, year, variety	Form	Application g ai/ha	g ai/hl	l/ha	No.	PHI (days)	Deltamethrin (mg/kg)	Report no.
Trebelshain, Sachsen, Germany, 1995, Kontrast	EG	6.3, 7.5	2.1, 2.5	300, 300	2	0 31 31	0.12 ear <0.02 grain 0.12 straw	A56788
East Winch, East Anglia, UK, 1995, Riband	EG	6.3, 7.5	3.15, 3.8	200, 200	2	0 30 30	0.07 ear <0.02 grain 0.41 straw	A56788

Barley. Field trials in Germany and the UK were reported in summary form only.

Table 94. Residues of deltamethrin in barley after EC applications.

Location, year, variety	Application g ai/ha	g ai/hl	l/ha	No.	PHI (days)	Deltamethrin (mg/kg)	Report no.
Scharmeck, Germany, 1980, Aramir	7.5	1.3	600	3	0 7 14 21 21	0.7 plant 0.8 plant 0.4 plant <0.05 straw 0.05 grain	A21549 A21550 A71908
Langenhain, Germany, 1980, Aramir	7.5	1.3	600	2	0 7 14 21 21	0.7 plant 0.3 plant 0.5 plant 0.1 straw 0.01 grain	A21551 A21552 A71908
Gersthofen, Germany, 1980, Europa	7.5	1.3	600	2	0 7 14 21 21	0.5 plant 1.0 plant 0.2 plant <0.02 straw 0.03 grain	A21553 A21554 A71908
Hattersheim, Germany, 1980, Europa	7.5	1.3	600	2	0 7 14 21 21	0.3 plant 0.3 plant 0.6 plant 0.04 straw 0.03 grain	A21555 A21556 A71908
Stelle, Germany, 1991, Alexis	4.4	1.5	300	1	0 0 4 4 7 7 15 15	0.08 plants 0.07 ears 0.08 plants 0.04 ears 0.07 plants 0.06 ears 0.15 straw 0.02 grain	A52603 A71908
Linsengericht, Germany, 1991, Alexis	4.4	1.5	300	1	0 0 2 2 8 8 13 13	0.08 plants 0.09 ears 0.08 plants 0.06 ears 0.06 plants 0.06 ears 0.19 straw 0.01 grain	A52603 A71908
Linsengericht, Germany, 1992, Alexis	4.3	1.4	300	1	0 0 2 2 7 7 14 14	0.09 plants 0.08 ears 0.08 plants 0.04 ears 0.07 plants 0.04 ears 0.1 straw 0.015 grain	A52604 A71908
Niekrenz, Germany, 1992, Alexis	4.3	1.4	300	1	0 0 3 3 12	0.18 plants 0.08 ears 0.17 plants 0.04 ears 0.16 plants	A52604 A71908

Location, year, variety	Application				PHI (days)	Deltamethrin (mg/kg)	Report no.
	g ai/ha	g ai/hl	l/ha	No.			
					12 19 19	0.04 ears 0.2 straw 0.015 grain	
Newark, Notts, UK, 1980, Marris Otter	7.5	3.3	225	1	0	0.05 grain	A40231 A71908

Oats. Field trials in Germany were reported in summary form only.

Table 95. Residues of deltamethrin in oats after applications of EC formulations.

Location, year, variety	Application				PHI (days)	Deltamethrin (mg/kg)	Report no.
	g ai/ha	g ai/hl	l/ha	No.			
Scharmbeck, Germany, 1978, Leander	13	2.1	600	1	0 5 22 28 40	0.02 ears <0.01 ears <0.01 ears <0.01 ears 0.06 straw	A16624 A71908
Langenhain, Germany, 1978, Tiger	13	2.1	600	1	0 7 20 37	0.02 ears <0.01 ears <0.01 ears 0.06 straw	A16625 A71908
Gersthofen, Germany, 1978, Tiger	13	2.1	600	1	0 11 21 42	<0.01 <0.01 <0.01 <0.05	A16626 A71908
Hattersheim, Germany, 1978, Erbgraf	13	2.1	600	1	0 7 14 28	<0.01 <0.01 <0.01 <0.08	A16627 A71908
Scharmbeck, Germany, 1979, Leander	13	2.1	600	1	0 14 21 28 31 31	0.3 plants <0.02 ears <0.02 ears <0.02 ears <0.02 grain 0.6 straw	A18849 A71908
Bornheim, Germany, 1979, Flämingskrone	13	2.1	600	1	0 14 21 29 29	0.02 ears 0.05 ears 0.05 ears <0.02 grain 0.2 straw	A18850 A71908
Gersthofen, Germany, 1979, Pivol	13	2.1	600	1	0 13 22 30 30	0.6 plant 0.1 ears 0.2 ears 0.03 grain 0.2 straw	A18851 A71908
Hattersheim, Germany, 1979, Flämingskrone	13	2.1	600	1	0 14 21 28 28	0.2 plant 0.1 ears <0.02 ears 0.02 grain 0.5 straw	A18899 A71908
Scharmbeck, Germany, 1980, Leander	7.5	1.3	600	3	0 14 21 21 28	0.06 plants 0.08 plants 0.08 plants 0.09 straw <0.01 grain	A21634 A21635 A71908
Langenhein, Germany, 1980, Flämingskrone	7.5	1.3	600	2	0 7 14 21 21	0.1 plants 0.08 plants <0.05 plants <0.05 straw <0.01 grain	A21636 A21637 A71908
Gersthofen,	7.5	1.3	600	2	0	0.2 plant	A21638

Location, year, variety	Application				PHI (days)	Deltamethrin (mg/kg)	Report no.
	g ai/ha	g ai/hl	l/ha	No.			
Germany, 1980, Pirol					7 14 21 21	0.1 plant 0.1 plant <0.05 straw <0.01 grain	A21639 A71908
Hattersheim, Germany, 1980, Flämingskrone	7.5	1.3	600	2	0 7 14 21 21	0.2 plant <0.05 plant 0.06 plant <0.05 plant <0.01 grain	A21640 A21641 A71908

Stored cereal grains

Maize. Trials were reported from France and Italy in which EC and DP formulations were applied to stored grain. Control samples fortified with deltamethrin were extracted and analysed with the treated samples. The GC/ECD method in all the storage trials where the method was reported was RU-78.10.07/A or a derivative. Recoveries from samples fortified at 0.2 mg/kg were 74 and 90%.

Table 96. Residues of deltamethrin in stored maize (corn) grain after EC and DP applications.

Location, year, variety	Application			Storage (days)	Residue (mg/kg)	Report no.
	Form	g ai/tonne	No.			
Saint Marcel, Marseille, France, 1982	EC	0.75	1	3 84 100 245 365	0.50 0.40 0.30 0.40 0.30	A71960
Saint Marcel, Marseille, France, 1982	EC	1	1	3 84 100 245 365	0.65 0.70 0.40 0.40 0.60	A71960
Grosseto, Italy, 1987	EC	0.27	1	0 42 91 182	0.099 0.09 0.17 0.088	C006274, C007897
Grosseto, Italy, 1987	DP	1	1	0 42 91 182	0.74 0.13 0.19 0.24	C006274, C007897
Grosseto, Italy, 1987	EC	1.2	1	0 42 91 182	0.34 0.33 0.25 0.21	C006274 C007897

Wheat. In trials in Australia, Belgium, Brazil, China, France, Greece, India, Italy, Morocco, the UK and the USA EC, DP, UL and WP formulations were applied to stored grain. The trials in Australia, China, Greece, India, Italy, Morocco, the UK and the USA were reported in summary form only.

Table 97. Residues of deltamethrin in wheat (stored grain) after applications of various formulations.

Location, year, variety	Application			Storage (days)	Residue (mg/kg)	Report no.
	Form	g ai/tonne	No.			
NSW Graincorp, Armatree, NSW, Australia, 1991, ASW grade	EC	0.25	1	56	0.2 0.7 bran 0.2 germ <LOD flour straight run 0.1 flour last reduction 0.3 pollard 0.04 flour 0.03 wholemeal	A71908

Location, year, variety	Application			Storage (days)	Residue (mg/kg)	Report no.
	Form	g ai/tonne	No.			
					0.10 white bread 0.07 wholemeal bread 0.08 flat bread 0.02 steamed bread 0.02 yellow alkaline noodles 0.02 white salted noodles	
NSW Graincorp, Armatree, NSW, Australia, 1991, ASW grade	EC	0.25	1	56	0.14 0.59 bran 0.32 germ 0.04 flour straight run 0.11 flour last reduction 0.28 pollard	A71908
NSW Graincorp, Armatree, NSW, Australia, 1991, ASW grade	EC	0.5	1	56	0.45 1.8 bran 0.6 germ 0.1 flour straight run 0.31 flour last reduction 1.1 pollard 0.1 flour 0.42 wholemeal 0.06 white bread 0.24 wholemeal bread 0.20 flat bread 0.06 steamed bread 0.09 yellow alkaline noodles 0.06 white salted noodles	A71908
NSW Graincorp, Armatree, NSW, Australia, 1991, ASW grade	EC	0.5	1	56	0.37 1.5 bran 0.63 germ 0.11 flour straight run 0.31 flour last reduction 0.86 pollard	A71908
NSW Graincorp, Armatree, NSW, Australia, 1991, ASW grade	EC	0.25	1	136	0.14 0.58 bran 0.03 germ 0.03 flour straight run 0.03 flour last reduction 0.33 pollard 0.03 9:1 wholemeal 0.02 flour 0.15 wholemeal 0.02 white bread 0.04 wholemeal bread 0.07 flat bread 0.02 steamed bread 0.02 yellow alkaline noodles 0.02 white salted noodles	A71908
NSW Graincorp, Armatree, NSW, Australia, 1991, ASW grade	EC	0.25	1	136	0.19 0.74 bran 0.29 germ 0.06 flour straight run 0.14 flour last reduction 0.42 pollard 0.21 9:1 wholemeal	A71908
NSW Graincorp, Armatree, NSW, Australia, 1991, ASW grade	EC	0.5	1	136	0.34 1.49 bran 0.59 germ 0.12 flour straight run 0.31 flour last reduction 0.38 pollard <LOD 9:1 wholemeal 0.11 flour 0.41 wholemeal 0.04 white bread	A71908

Location, year, variety	Application			Storage (days)	Residue (mg/kg)	Report no.
	Form	g ai/tonne	No.			
					0.15 wholemeal bread 0.20 flat bread 0.06 steamed bread 0.07 yellow alkaline noodles 0.04 white salted noodles	
NSW Graincorp, Armatree, NSW, Australia, 1991, ASW grade	EC	0.5	1	136	0.38 1.45 bran 0.58 germ 0.12 flour straight run 0.34 flour last reduction 0.92 pollard 0.37 9:1 wholemeal	A71908
NSW Graincorp, Armatree, NSW, Australia, 1991, ASW grade	EC	0.25	1	70	0.11 0.36 bran 0.11 germ 0.02 flour straight run 0.02 flour last reduction	A71908
NSW Graincorp, Armatree, NSW, Australia, 1991, ASW grade	EC	0.25	1	70	0.18 0.48 bran 0.17 germ 0.10 flour straight run 0.06 flour last reduction	A71908
NSW Graincorp, Armatree, NSW, Australia, 1991, ASW grade	EC	0.25	1	70	0.26 0.57 bran 0.02 flour straight run 0.12 flour last reduction	A71908
NSW Graincorp, Armatree, NSW, Australia, 1991, ASW grade	EC	0.5	1	70	0.42 1.1 bran 0.34 germ 0.18 flour straight run 0.19 flour last reduction	A71908
NSW Graincorp, Armatree, NSW, Australia, 1991, ASW grade	EC	0.25	1	105	0.08 0.27 bran <LOD germ <LOD flour straight run <LOD flour last reduction	A71908
NSW Graincorp, Armatree, NSW, Australia, 1991, ASW grade	EC	0.25	1	105	0.28 0.64 bran 0.17 germ 0.09 flour straight run 0.15 flour last reduction 0.11 wheatmeal	A71908
NSW Graincorp, Armatree, NSW, Australia, 1991, ASW grade	EC	0.5	1	105	0.32 0.97 bran 0.27 germ 0.15 flour straight run	A71908
NSW Graincorp, Armatree, NSW, Australia, 1991, ASW grade	EC	0.5	1	105	0.42 1.3 bran 0.36 germ 0.16 flour straight run 0.32 wheatmeal	A71908
Wail silo, Victoria, Australia, 1981	EC	1	1	40 40 40 81 81 81 186 186 186 281 281 281 383	0.2 1.4 bran 0.07 flour 0.3 0.9 bran 0.075 flour 0.4 1.2 bran 0.07 flour 0.4 1.2 bran 0.01 flour 0.25	A71908

Location, year, variety	Application			Storage (days)	Residue (mg/kg)	Report no.
	Form	g ai/tonne	No.			
				383	1.3 bran	
				383	0.06 flour	
Wattamondra, NSW, Australia, 1981	EC	1	1	40	0.15	A71908
				40	1.3 bran	
				40	0.06 flour	
				81	0.4	
				81	1.2 bran	
				81	0.065 flour	
				186	0.3	
				186	1.0 bran	
				186	0.07 flour	
				281	0.45	
				281	1.0 bran	
				281	0.02 flour	
Grenfell silo, NSW, Australia, 1981	EC	1	1	40	0.25	A71908
				40	1.1 bran	
				40	0.05 flour	
				81	0.35	
				81	0.8 bran	
				81	0.07 flour	
				186	0.3	
				186	1.4 bran	
				186	0.07 flour	
				281	0.35	
				281	1.5 bran	
				281	0.01 flour	
Quairading, WA, Australia, 1980	EC	1	1	48	0.2	A71908
				48	0.85 bran	
				48	0.06 flour	
				118	0.5	
				118	1.1 bran	
				118	0.085 flour	
				223	0.4	
				223	1.4 bran	
				223	0.07 flour	
				318	0.35	
				318	0.75 bran	
				318	0.01 flour	
				420	0.2	
				420	1.2 bran	
				420	0.06 flour	
Malu silo, Queensland, Australia, 1980	EC	1	1	77	0.3	A71908
				77	1.2 bran	
				77	0.06 flour	
				137	0.5	
				137	1.3 bran	
				137	0.065 flour	
				242	0.25	
				242	0.5 bran	
				242	0.06 flour	
				337	0.4	
				337	0.3 bran	
				337	0.01 flour	
Gembloux, Belgium, 1978	EC	0.7	1	7	0.56	A71908
				27	0.70	A71939
				93	0.35	
				93	0.065 flour	
				93	0.65 bran	
				240	0.27	
				240	0.1 flour	
				240	0.2 bran	
Gembloux, Belgium, 1978	EC	0.85	1	7	0.69	A71908
				27	1.0	A71939
				93	0.5	

Location, year, variety	Application			Storage (days)	Residue (mg/kg)	Report no.
	Form	g ai/tonne	No.			
				93 93 240 240 240	0.07 flour 1.0 bran 0.47 0.25 flour 1.3 bran	
Gembloux, Belgium, 1978	EC	1	1	7 27 93 93 93 240 240 240	0.78 1.1 0.7 0.09 flour 1.2 bran 0.69 0.4 flour 1.7 bran	A71908 A71939
Rio De Janeiro, Brazil, 1982	DP	0.35	1	175	0.08	A71908 A71932
Rio De Janeiro, Brazil, 1982	DP	0.5	1	175	0.18	A71908 A71932
Rio De Janeiro, Brazil, 1982	DP	0.75	1	175	0.09	A71908 A71932
Rio De Janeiro, Brazil, 1982	DP	0.35	1	30 60 90 130	0.02 0.06 0.12 0.12	A71908 A71933
Rio De Janeiro, Brazil, 1982	DP	0.5	1	30 60 90 130	0.06 0.15 0.07 0.10	A71908 A71933
Rio De Janeiro, Brazil, 1982	DP	0.75	1	30 60 90 130	0.059 0.059 0.21 0.12	A71908 A71933
Henan, China, 1982	EC	0.5	1	730	0.021	A71908
Henan, China, 1982	EC	1	1	730	0.04	A71908
Henan, China, 1982	EC	1.5	1	730	0.051	A71908
Shanghai, China, 1984	EC	0.5	1	236	0.38, 0.29	A71908
Shanghai, China, 1984	EC	1	1	236	0.72, 0.85	A71908
Shanghai, China, 1984	EC	1.5	1	236	1.13, 1.3	A71908
Silos Jean Sourbet, France. 1982	UL	0.5	1	0 94 187 319 360	0.3 0.25 0.4 0.3 0.3	A71908
Silos Jean Sourbet, France. 1982	UL	0.75	1	0 94 187 319 360	0.5 0.45 0.5 0.5 0.5	A71908
Athens, Greece, 1980	EC	0.25	1	6 90 180 270	0.13 0.10 0.13 0.16	A71908
Athens, Greece, 1980	EC	0.5	1	6 90 180 270	0.25 0.25 0.27 0.27	A71908
Athens, Greece, 1979	EC	0.75	1	119	0.29	A71908
Athens, Greece, 1979	EC	1	1	167	0.31	A71908
Tamil Nadu, India, 1987	WP	1	1	0 30 60 90	0.63 0.47 0.31 0.30	A71908

Location, year, variety	Application			Storage (days)	Residue (mg/kg)	Report no.
	Form	g ai/tonne	No.			
				120	0.31	
				150	0.21	
Tamil Nadu, India, 1987	WP	2	1	0	2.16	A71908
				30	1.88	
				60	1.0	
				90	1.02	
				120	0.92	
				150	0.55	
				180	0.47	
Tamil Nadu, India, 1987, wheat (bagged)	WP	0.025/m^2	1	0	<0.01	A71908
				7	<0.01	
				14	<0.01	
				28	<0.01	
Tamil Nadu, India, 1987, wheat (bagged)	WP	0.05/m^2	1	0	<0.01	A71908
				7	<0.01	
				14	<0.01	
				28	<0.01	
Turrume, Italy, 1995, Podura (hard wheat)	DP	1	1	0	0.47	A71908
				41	0.30	
				90	0.39	
Turrume, Italy, 1995, Podura (hard wheat)	DP	2	1	0	1.3	A71908
				41	0.595	
				90	0.673	
La Specia, Italy, 1985, (hard wheat)	UL	0.25	1	0	0.093	A71908
				44	0.037	
				44	<LOD milling wheat	
				44	<LOD cleaned wheat	
				44	0.587 cleaning impurities	
				44	0.003 decorticated	
				44	1.3 decorticated residue	
				44	0.026 bran	
				44	0.042 grits or flour	
				93	0.010	
				183	0.084	
				183	0.05	
				183	0.028 cleaned wheat	
				183	0.88 cleaning impurities	
				183	0.039 decorticated	
				183	0.83 decorticated residue	
				183	0.057 bran	
				183	<LOD grits or flour	
La Specia, Italy, 1985, (hard wheat)	UL	0.5	1	0	0.30	A71908
				43	0.10	
				92	0.095	
				182	0.16	
La Specia, Italy, 1986, (hard wheat)	UL	1	1	0	0.35	A71908
				42	0.099	
				42	0.22 milling wheat	
				42	0.15 cleaned wheat	
				42	4.0 cleaning impurities	
				42	0.12 decorticated	
				42	2.2 decorticated residue	
				42	0.57 bran	
				42	0.13 grits or flour	
				90	0.20	
				181	0.42	
				181	0.46	
				181	0.27 clean grain	
				181	6.1 cleaning impurities	
				181	0.36 decorticated	
				181	2.8 decorticated residue	
				181	0.24 bran	
				181	0.061 grits or flour	

Location, year, variety	Application			Storage (days)	Residue (mg/kg)	Report no.
	Form	g ai/tonne	No.			
Lendinara, Italy, 1985, Mec (soft wheat)	UL	0.25	1	0	0.024	A71908
				42	0.086	
				42	0.008 milling wheat	
				42	0.003 cleaned wheat	
				42	1.0 cleaning impurities	
				42	<LOD decorticated	
				42	1.2 decorticated residue	
				42	0.10 bran	
				42	0.019 grits or flour	
				89	0.010	
				89	<LOD milling wheat	
				89	<LOD cleaned wheat	
				89	0.33 cleaning impurities	
				89	<LOD decorticated	
				89	1.2 decorticated residue	
				89	<LOD bran	
				89	<LOD grits or flour	
Lendinara, Italy, 1985, Mec (soft wheat)	UL	0.5	1	0	0.029	A71908
				42	0.12	
				89	0.084	
				89	0.04 milling wheat	
				89	0.009 cleaned wheat	
				89	1.0 cleaning impurities	
				89	0.013 decorticated	
				89	2.0 decorticated residue	
				89	0.30 bran	
				89	<LOD grits or flour	
Lendinara, Italy, 1985, Mec (soft wheat)	UL	1	1	0	0.17	A71908
				42	0.43	
				42	0.30 milling wheat	
				42	0.38 cleaned wheat	
				42	6.7 cleaning impurities	
				42	0.17 decorticated	
				42	7.8 decorticated residue	
				42	0.53 bran	
				42	0.11 grits or flour	
				89	0.34	
				89	0.31 milling wheat	
				89	0.14 cleaned wheat	
				89	6.8 cleaning impurities	
				89	0.15 decorticated	
				89	3.9 decorticated residue	
				89	0.81 bran	
				89	<LOD grits or flour	
San Giorgio di Piano, Italy, 1985, Creso (hard wheat)	EC	0.25	1	0	0.077	A71908
				46	0.088	
				92	0.056	
				191	0.27	
San Giorgio di Piano, Italy, 1985, Creso (hard wheat)	EC	0.5	1	0	0.12	A71908
				45	0.39	
				45	0.017 milling wheat	
				45	0.010 cleaned wheat	
				45	1.1 cleaning impurities	
				45	0.003 decorticated	
				45	0.31 decorticated residue	
				45	0.018 bran	
				45	0.013 grits or flour	
				91	0.56	
				190	0.78	
				190	0.029 milling wheat	
				190	0.014 cleaned wheat	
				190	0.46 cleaning impurities	
				190	0.039 decorticated	
				190	0.56 decorticated residue	

Location, year, variety	Application			Storage (days)	Residue (mg/kg)	Report no.
	Form	g ai/tonne	No.			
				190	0.15 bran	
				190	0.022 grits or flour	
				365	0.16	
San Giorgio di Piano, Italy, 1985, Creso (hard wheat)	EC	1	1	0	0.17	A71908
				44	1.3	
				44	0.22 milling wheat	
				44	0.091 cleaned wheat	
				44	6.4 cleaning impurities	
				44	0.038 decorticated	
				44	1.6 decorticated residue	
				44	0.22 bran	
				44	0.025 grits or flour	
				90	0.80	
				189	1.4	
				189	0.45 milling wheat	
				189	0.057 cleaned wheat	
				189	2.5 cleaning impurities	
				189	0.086 decorticated	
				189	3.2 decorticated residue	
				189	0.33 bran	
				189	0.011 grits or flour	
				203	1.1	
				365	0.51	
Lendinara, Italy, 1985, Manital (soft wheat)	EC	0.25	1	0	0.12	A71908
				43	0.14	
				90	0.085	
Lendinara, Italy, 1985, Manital (soft wheat)	EC	0.5	1	0	0.11	A71908
				43	0.11	
				90	0.069	
Lendinara, Italy, 1985, Manital (soft wheat)	EC	1	1	0	0.21	A71908
				43	0.36	
				90	0.28	
Montepescali, Italy, 1986, (soft wheat)	EC	0.25	1	0	0.13	A71908
				43	0.064	
				95	0.064	
				185	0.10	
				365	0.089	
Montepescali, Italy, 1986, (soft wheat)	EC	0.5	1	0	0.24	A71908
				43	0.24	
				95	0.32	
				185	0.24	
				365	0.26	
Montepescali, Italy, 1986, (soft wheat)	EC	1	1	0	0.28	A71908
				43	0.31	
				95	0.47	
				185	0.45	
				365	0.44	
Ponte a Rigo, Italy, 1986, (soft wheat)	EC	0.25	1	0	0.11	A71908
				43	0.074	
				43	0.061 milling wheat	
				43	<LOD cleaned wheat	
				43	4.3 cleaning impurities	
				43	0.0 decorticated	
				43	0.62 decorticated residue	
				43	0.43 bran	
				43	<LOD grits or flour	
				90	0.050	
				155	0.11	
				180	0.10	
				180	0.08 milling wheat	
				180	0.058 cleaned wheat	
				180	4.9 cleaning impurities	
				180	0.06 decorticated	
				180	1.7 decorticated residue	

Location, year, variety	Application			Storage (days)	Residue (mg/kg)	Report no.
	Form	g ai/tonne	No.			
				180	0.13 bran	
				180	0.034 grits or flour	
				365	0.16	
Ponte a Rigo, Italy, 1986, (soft wheat)	EC	0.5	1	0	0.32	A71908
				43	0.15	
				90	0.11	
				155	0.25	
				180	0.20	
				365	0.35	
Ponte a Rigo, Italy, 1986, (soft wheat)	EC	1	1	0	0.44	A71908
				43	0.29	
				43	0.37 milling wheat	
				43	0.16 cleaned wheat	
				43	8.4 cleaning impurities	
				43	0.16 decorticated	
				43	3.9 decorticated residue	
				43	0.45 bran	
				43	<LOD grits or flour	
				90	0.30	
				155	0.52	
				180	0.45	
				180	0.37 milling wheat	
				180	0.24 cleaned wheat	
				180	5.7 cleaning impurities	
				180	0.28 decorticated	
				180	8.7 decorticated residue	
				180	1.8 bran	
				180	<LOD grits or flour	
				365	0.46	
Fez, Morocco, 1985	DP	1	1	2	0.30, 0.25, 0.25, 0.18	A71908
				120	0.12	
				245	0.58	
				365	0.50	
Marrakech, Morocco, 1977	DP	0.25	1	68	0.015, <LOD, 0.10, 0.06	A71908
Berkhamsted, UK, 1979, Timmo (hard wheat)	EC	1	1	0	0.44	A71908
				0	0.42 wholemeal flour	
				0	0.26 wholemeal bread	
				0	3.0 bran	
				0	<LOD fine offal	
				0	<LOD 1st reduction flour	
				0	0.09 total white flour	
				31	0.53	
				62	0.48	
				93	0.5	
				93	0.43 wholemeal flour	
				93	0.27 wholemeal bread	
				93	1.8 bran	
				93	0.5 fine offal	
				93	<LOD 1st reduction flour	
				93	0.05 total white flour	
				93	<LOD white bread	
Berkhamsted, UK, 1979, Timmo (hard wheat)	EC	1	1	0	0.80	A71908
				0	0.73 wholemeal flour	
				0	0.63 wholemeal bread	
				0	5.4 bran	
				0	<LOD fine offal	
				0	<LOD 1st reduction flour	
				0	0.20 total white flour	
				0	0.29 white bread	
				31	1.3	
				62	1.3	
				93	1.5	
				93	0.80 wholemeal flour	

Location, year, variety	Application			Storage (days)	Residue (mg/kg)	Report no.
	Form	g ai/tonne	No.			
				93 93 93 93 93 93	0.57 wholemeal bread 4.7 bran 0.75 fine offal <LOD 1st reduction flour 0.20 total white flour 0.15 white bread	
Gustafen RandD Center, McKinney, Texas, USA, 1992, Florida 302	EC	0.5	1	0	0.37 0.95 bran <LOD flour 0.26 middlings 0.25 shorts	A71908

Barley. In trials in France EC and UL formulations were applied to stored grain. Control samples fortified with deltamethrin were extracted and analysed with the treated samples. Method RU-78.10.07/A was used in the 1983 trial with a reported recovery of 75%. The report of the other trial in France did not include the year of the study, storage period or any details of analytical methods.

Table 98. Residues of deltamethrin in barley (stored grain) after EC and UL applications.

Location, year, variety	Application			Storage (days)	Residue (mg/kg)	Report no.
	Form	g ai/tonne	No.			
Marseille, France, 1983, Carina	EC	1	1	3 80 160 160 245 245 365 365	0.8 0.8 0.9 <LOD malt germ 0.3 <LOD malt germ 0.4 <LOD malt germ	A71908
Vandoeuvre, France, 19xx, Natasha 2	UL	0.55	1	?	0.05 0.02 malt <LOD beer malt	A71908

Sorghum . In trials in Brazil, France and the USA EC and DP formulations were applied to stored grain. Control samples fortified with deltamethrin were extracted and analysed with the treated samples. Method RU-78.10.07/A was used in the 1982 trials in France with recoveries of 75 and 85% reported. The other trials were reported in summary form only.

Table 99. Residues of deltamethrin in stored sorghum grain after DP and EC applications.

Location, year, variety	Application			Storage (days)	Residue (mg/kg)	Report no.
	Form	g ai/tonne	No.			
Rio de Janeiro, Brazil, 1982	DP	0.35	1	30 60 90 130 175	0.10 0.008 0.13 0.12 0.12	A71951
Rio de Janeiro, Brazil, 1982	DP	0.5	1	30 60 90 130 175	0.10 0.029 0.14 0.052 0.17	A71951
Saint Marcel, Marseille, France, 1982	EC	1	1	3 84 160 245 365	0.70 0.70 0.40 0.50 0.50	A71953 A71951

Location, year, variety	Application			Storage (days)	Residue (mg/kg)	Report no.
	Form	g ai/tonne	No.			
Saint Marcel, Marseille, France, 1982	EC	0.75	1	3 81 160 245 365	0.40 0.40 0.45 0.30 0.40	A71951?
Saint Marcel, Marseille, France, 1982	EC	1	1	3 84 160 245 365	0.70 0.60 0.70 0.40 0.50	A71951?
Saint Marcel, Marseille, France, 1982	EC	0.75	1	3 84 160 245 365	0.40 0.40 0.45 0.30 0.40	A71951 A71956
Saint Marcel, Marseille, France, 1982	EC	1.0	1	3 84 160 245 365	0.70 0.60 0.70 0.40 0.50	A71951
Gustafson R+D Center, McKinney, Texas, USA, 1992, Funks 1492	EC	0.5	1	0	0.36 whole grain 0.12 flour 0.40 whole grain <LOD starch	A71951

Rice. In trials in Brazil and France an EC formulation was applied to stored rice. Control samples fortified with deltamethrin were extracted and analysed with the treated samples. Method RU-78.10.07/F was used in the 1982 trials in France.

Table 100. Residues of deltamethrin in rice (stored grain) after applications of various deltamethrin formulations.

Location, year, variety	Application		Storage (days)	Residue (mg/kg)	Report no.
	g ai/tonne	No.			
Rio de Janeiro, Brazil, 1982	0.3	1	30 60 90 120 150 190	0.21 0.14 0.16 0.069 0.069 0.099	A71999
Rio de Janeiro, Brazil, 1982	0.5	1	30 60 90 120 150 190	0.17 0.26 0.27 0.038 0.071 0.12	A71999
Rio de Janeiro, Brazil, 1982	0.75	1	30 60 90 120 150 190	0.33 0.37 0.26 0.15 0.08 0.12	A71999
Saint Marcel, Marseille, France, 1982	0.75	1	3 84 160 245 365 3 84 160 245 365	0.50 grain 0.50 0.55 0.35 0.25 0.03 husked rice 0.02 <0.02 <0.02 <0.02	A71998

Location, year, variety	Application		Storage	Residue	Report no.
	g ai/tonne	No.	(days)	(mg/kg)	
Saint Marcel, Marseille, France, 1982	1	1	3 84 160 245 365 3 84 160 245 365	0.80 grain 0.70 0.80 0.45 0.30 0.05 husked rice 0.02 <0.02 <0.02 <0.02	A71998

Tea. In field trials in India, Malawi and Taiwan an EC formulation was applied to crops. Plot sizes in 2001 in India were 210-501 m^2 and in Malawi in 1988 25 plants. The storage period for samples in India was 14 months in 1979, 2-3 months in 1983 and 218-243 days in 2001, and in Taiwan 1-2 months. Control samples fortified with deltamethrin were extracted and analysed with the treated samples. Method RU-78.10.07/A was used in India in 1979 and 1983 and in Taiwan in 1979 with recoveries of 95% from processed black tea leaf and tea leaf fortified at 0.05 mg/kg and tea water at 0.005 mg/kg. In Malawi in 1988 Method B (Trav. Soc. Pharm. Montpellier, 1979, 329-336) was used with recoveries from leaves fortified at 0.02 mg/kg of 100%, and in 2001 method DGM F01/97-0 with recoveries from leaves fortified at 0.02 mg/kg of 96, 99, 115, 107 and 170%, from black tea at 2.0 mg/kg 108 and 96%, from withered leaves at 2.0 mg/kg 105 and 91%, from leaves after crush tear curl (CTC) at 2.0 mg/kg 90 and 102% and from material after fermentation at 2.0 mg/kg 99 and 106%. Tea water was prepared by adding leaves to boiling water, infusing for 5-10 minutes and filtering.

Table 101. Residues of deltamethrin in tea (*camellia sinensis*) after EC applications.

Location, year, variety	Application				PHI	Deltamethrin	Report no.
	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Bagdogra, West Bengal, India, 2001, TV 26	10.1	2.02	500	4	0 1 2 2 2 2 3 3 7	1.8 leaf 1.6 leaf 2.0 leaf 2.5 LW[1] 1.7 LC[2] 2.0 LF[3] 1.8 leaf 2.2 black tea 0.5 leaf	C016591
Bagdogra, West Bengal, India, 2001, VT 22	10.1	2.02	500	4	0 1 2 2 2 2 3 3 7	2.2 leaf 1.9 leaf 0.97 leaf 1.6 LW[1] 1.5 LC[2] 1.3 LF[3] 1.6 leaf 2.2 black tea 0.88 leaf	C016591
Malbazar, West Bengal, India, 2001, TV 9	10.1	2.02	500	4	0 1 3 7	2.4 leaf 2.2 leaf 1.5 leaf 0.72 leaf	C016591
Hashimara, West Bengal, India, 2001, VP 61	10.1	2.02	500	4	0 1 3 7	1.4 leaf 1.4 leaf 0.97 leaf 1.5 leaf	C016591
Gudalur, Tamil Nadu, India, 2001, VP 61	10.1	2.02	500	4	0 1 3 7	1.5 leaf 1.2 leaf 0.64 leaf 0.20 leaf	C016591

Location, year, variety	Application				PHI	Deltamethrin	Report no.
	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Kenthurai, Tamil Nadu, India, 2001, VP 62	10.1	2.02	500	4	0 1 3 7	1.3 leaf 1.1 leaf 0.82 leaf 0.40 leaf	C016591
Kattabattu, Tamil Nadu, India, 2001, VP 61	10.1	2.02	500	4	0 1 3 3 4 7	1.5 leaf 0.99 leaf 0.71 leaf 0.72 leaf 0.77 black tea 0.54 leaf	C016591
Thuneri, Tamil Nadu, India, 2001, VP 61	10.1	2.02	500	4	0 1 3 3 4 7	1.6 leaf 1.2 leaf 0.90 leaf 0.83 leaf 2.3 black tea 0.40 leaf	C016591
Tocklai, India, 1979	10			1	1 2 4 7 1 2 4 7	5.5 tea leaf 2.1 1.7 1.0 <0.0005 tea water <0.0005 <0.0005 <0.0005	
Tocklai, India, 1979	15			1	1 2 4 7 1 2 4 7	7.8 tea leaf 5.1 2.9 2.3 <0.0005 tea water 0.0005 <0.0005 <0.0005	A31644
Cinchona, India, 1983, Black tea	5			1	7	0.21, 0.22, 0.22 blk t <0.0005 (3) tea water	A71836
Cinchona, India, 1983, Black tea	10			1	7	0.36, 0.42 (2) black tea <0.0005 (3) tea water	A71836
Cinchona, India, 1983, Black tea	5			2	3	0.6, 0.7, 0.7 black tea <0.0005 (3) tea water	A71836
Cinchona, India, 1983, Black tea	10			2	7	1.0, 1.2, 1.1 black tea <0.0005 (3) tea water	A71836
Cinchona, India, 1983, Black tea	5			1	0 3 5 7 10 14 21 0 3 5 7 10 14 21	0.34 black tea 0.22 0.65 0.48 0.59 0.45 0.45 <0.0005 tea water <0.0005 tea water <0.0005 tea water <0.0005 tea water <0.0005 tea water <0.0005 tea water <0.0005 tea water	A71836
Cinchona, India, 1983, Black tea	5			1	0 3 5 7 10 14 21 0 3 5	1.7 black tea 1.0 1.5 1.0 0.57 0.40 0.42 <0.0005 tea water <0.0005 tea water <0.0005 tea water	A71836

Location, year, variety	Application				PHI	Deltamethrin	Report no.
	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
					7	<0.0005 tea water	
					10	<0.0005 tea water	
					14	<0.0005 tea water	
					21	<0.0005 tea water	
Cinchona, India, 1983, Black tea	10			1	0	2.7 black tea	A71836
					3	2.3	
					5	0.40	
					7	0.48	
					10	0.55	
					14	0.80	
					21	0.25	
					0	<0.0005 tea water	
					3	<0.0005 tea water	
					5	<0.0005 tea water	
					7	<0.0005 tea water	
					10	<0.0005 tea water	
					14	<0.0005 tea water	
					21	<0.0005 tea water	
Cinchona, India, 1983, Black tea	10			1	0	2.7 black tea	A71836
					3	3.1	
					5	1.3	
					7	0.9	
					10	0.65	
					14	0.65	
					21	0.25	
					0	<0.0005 tea water	
					3	<0.0005 tea water	
					5	<0.0005 tea water	
					7	<0.0005 tea water	
					10	<0.0005 tea water	
					14	<0.0005 tea water	
					21	<0.0005 tea water	
Mulanje, Malawi, 1988, China hybrid (local Jat)	3.12	1.0	300	1	3	0.15 black tea leaf	A71840
					3	<0.05 tea water	
					5	0.10 black tea leaf	
					5	<0.05 tea water	
					7	0.10 black tea leaf	
					9	0.15	
					11	0.15	
Mulanje, Malawi, 1988, China hybrid (local Jat)	6.3	1.0	300	1	3	1.0 black tea leaf	A71841
					3	<0.05 tea water	
					5	0.90 black tea leaf	
					5	<0.05 tea water	
					7	0.80 black tea leaf	
					9	0.40	
					11	0.20	
Taiwan, 1979, Green tea	6.6	0.83	800	1	0	3.1 tea leaf	A31643
					3	3.0	
					5	1.1	
					10	0.75	
					15	0.65	
					0	0.001 tea water	
					3	0.0005	
					5	0.0006	
					10	<0.0005	
					15	<0.0005	
Taiwan, 1979, Green tea	10	1.3	800	1	0	4.3 tea leaf	A31643
					3	1.6	
					5	1.4	
					10	1.5	
					15	0.85	
					0	0.002 tea water	
					3	0.0005	
					5	0.0009	

Location, year, variety	Application				PHI	Deltamethrin	Report no.
	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
					10	<0.0005	
					15	<0.0005	
Taiwan, 1979, Green tea	13.3	1.66	800	1	0	3.2 tea leaf	A31643
					3	3.2	
					5	2.5	
					10	1.9	
					15	1.2	
					0	0.002 tea water	
					3	0.0013	
					5	0.0009	
					10	<0.0005	
					15	<0.0005	
Taiwan, 1979, Green tea	20	2.5	800	1	0	2.5 tea leaf	A31643
					3	4.8	
					5	3.4	
					10	2.4	
					15	1.5	
					0	0.005 tea water	
					3	0.001	
					5	0.0008	
					10	<0.0005	
					15	<0.0005	
Taiwan, 1979, Green tea	20	2.5	800	1	0	2.5 tea leaf	A31643
					3	4.8	
					5	3.4	
					10	2.4	
					15	1.5	
					0	0.005 tea water	
					3	0.001	
					5	0.0008	
					10	<0.0005	
					15	<0.0005	

[1] leaf after withering
[2] leaf after curl, tear and crush
[3] leaf after fermentation

Cacao. In field trials in the Côte d'Ivoire an EC formulation was applied to cacao crops. The interval between sampling and analysis was 12-14 months. The methods of analysis were FP-77.30.11 with a recovery of 90% reported for a sample fortified at 0.001 mg/kg and RU-78 11 07/A with a recovery of 90% from a sample fortified at 0.005 mg/kg.

Table 102. Residues of deltamethrin in cacao after EC applications.

Location, year, variety	Application				PHI	Deltamethrin	Report no.
	g ai/ha	g ai/hl	l/ha	No.	(days)	(mg/kg)	
Abengourou, Côte d'Ivoire, 1977	6.3	0.78	80	8	38	0.006 fresh bean	A71873 A71872
	18.8	2.34	80	8	38	0.007 fresh bean	A71872 A71873
	18.8	2.34	80	8	38	0.025 fresh bean	A71872 A71873
Bouaké, Côte d'Ivoire, 1978, Amelonado	18.8	2.68	70	3	72	<0.005 fresh bean	A71872 A71875

Coffee. In field trials in Brazil and the Côte d'Ivoire an EC formulation was applied to crops. The trial reports were only in summary form.

In trials in Brazil and France EC and DP formulations were applied to stored green coffee beans. The interval between sampling and analysis was 3 months in Brazil in 1977. The method of

analysis was RU-78 11.07/A for all trials with a recovery of 85% from unroasted beans fortified at 0.005 mg/kg.

Table 103. Residues of deltamethrin in coffee after EC and DP applications.

Location, year, variety	Application					Days after last application	Deltamethrin (mg/kg)	Ref.
	Form	g ai/ha	g ai/hl	l/ha	No.			
Field trials								
Machado, Brazil, 1977, Mundo Novo	EC	6.3	3.1	200	1	1 15 28	<0.005 green bean <0.005 <0.005	A71895
Machado, Brazil, 1977, Mundo Novo	EC	13	6.3	200	1	1 15 28	<0.005 green bean <0.005 <0.005	A71895
Machado, Brazil, 1977, Mundo Novo	EC	6.3	3.1	200	2	1	<0.005 green bean	A71895
Machado, Brazil, 1977, Mundo Novo	EC	13	6.3	200	2	1	0.02 green bean	A71895
Espirito Santo, Brazil, 1977, Mundo Novo	EC	10	6.7	150	2	46	<0.005 bean	A71895
Abengourou, Côte d'Ivoire, 1977, Ineac	EC	13	13	80	2	198	<0.005 green bean	A71895
Abengourou, Côte d'Ivoire, 1977, Ineac	EC	19	23	80	2	198	<0.005 green bean	A71895
Bouaké, Côte d'Ivoire, 1978, Robusta	EC	19	27	70	2	178	<0.005 green bean	A71895
Stored beans								
Sao Paulo, Brazil, 1977, Mundo Novo	DP	1 g/tonne			1	240	0.95 bean	A31652
Sao Paulo, Brazil, 1977, Mundo Novo	DP	2 g/tonne			1	240	1.65 bean	A31652
Rio de Janeiro, Brazil, 1981, Mundo Novo (fortified samples)	EC	0.5 g/tonne			1		0.3 <0.01 roasted <0.01 grounds <0.01 water	A31656
Rio de Janeiro, Brazil, 1981, Mundo Novo (fortified samples)	EC	0.75 g/tonne			1		0.45 <0.01 roasted <0.01 grounds <0.01 water	A31656
Rio de Janeiro, Brazil, 1981, Mundo Novo (fortified samples)	EC	1 g/tonne			1		0.8 <0.01 roasted <0.01 grounds <0.01 water	A31656
Saint Marcel, Marseille, France, 1982	EC	1 g/tonne			1	3 80 160 245 365 3 80 160 245 365 3 80 160 245 365	0.6 green beans 0.55 0.45 0.45 0.3 <0.05 roasted <0.05 <0.05 <0.05 <0.05 <0.001 drink <0.001 drink <0.001 drink <0.001 drink <0.001 drink	A31657
Montpellier, France, 1980, Nuovo (fortified samples)	EC	0.5 g/tonne			1		0.35 unroasted <0.01 roasted	A31655
Montpellier, France, 1980, Nuovo	EC	1 g/tonne			1		0.85 unroasted <0.01 roasted	A31655

Location, year, variety	Application					Days after last application	Deltamethrin (mg/kg)	Ref.
	Form	g ai/ha	g ai/hl	l/ha	No.			
(fortified samples)								

Pasture. In the New Zealand trial on alfalfa (lucerne) the interval between sampling and analysis was approximately 3 months. Method RU-78.11.07/F was used giving recoveries from a sample fortified at 0.88 mg/kg of 88%. The trials conducted in Canada were reported in summary form only.

Table 104. Residues of deltamethrin in pasture (lucerne, bromegrass, crested wheat grass) after EC applications.

Location, year, variety	Application				PHI days	Deltamethrin (mg/kg)	Report no.
	g ai/ha	g ai/hl	l/ha	No.			
Lucerne							
Pukekohe, New Zealand, 1979	10	2.22	450	1	1 3 8 15 23	0.25 0.25 0.23 0.09 <0.01	A71894 A21287
Tarascon, France, 1978, Luzerne de Provence	12.5	1.25	1000	2	2 5 7 14	1.5 1.0 0.45 0.11	A71894
Tarascon, France, 1978, Luzerne de Provence	12.5	1.25	1000	2	2 5 7 14	1.6 0.75 0.48 0.10	A71894
Tarascon, France, 1979, Luzerne de Provence	12.5	1.25	1000	2	8 15 22	1.0 0.16 0.1	A71894
Tarascon, France, 1979, Luzerne de Provence	12.5	1.25	1000	2	7 14 21	0.25 0.07 0.03	A71894
Grass							
Regina, Saskatchewan, Canada, 1983, Bromegrass	7.5	6.8	110	3	1 3 7 14 21	0.86 (1.9 dry weight) 0.60 (1.4 dry weight) 0.85 (2.1 dry weight) 0.24 (0.48 dry weight) 0.35 (0.83 dry weight)	A72643 A71894 corrected for recoveries
Regina, Saskatchewan, Canada, 1983, Bromegrass	15	13.6	110	3	1 3 7 14 21	2.7 (5.1 dry weight) 1.3 (3.0 dry weight) 1.9 (4.6 dry weight) 1.2 (2.8 dry weight) 1.1 (2.3 dry weight)	A72643 A71894 Corrected for recoveries
Regina, Saskatchewan, Canada, 1983, Crested wheat grass	7.5	6.8	110	3	1 3 7 14 21	1.5 (2.3 dry weight) 1.0 (2.0 dry weight) 0.76 (1.5 dry weight) 0.42 (0.90 dry weight) 0.41 (0.71 dry weight)	A72644 A71894
Regina, Saskatchewan, Canada, 1983, Crested wheat grass	15	13.6	110	3	1 3 7 14 21	2.9 (4.6 dry weight) 2.3 (4.1 dry weight) 2.4 (4.5 dry weight) 1.9 (3.3 dry weight) 1.0 (1.7 dry weight)	A72644 A71894
Hamilton, New Zealand, 1978, Rye grass and clover	5	0.77	650	1	0 1 2 4 6	0.52 all fresh grass 0.42 0.4 0.2 0.13	A71894
Hamilton, New Zealand, 1978, Rye grass and clover	10	1.4	650	1	0 1 2 4 6	1.1 all fresh grass 1.1 0.8 0.67 0.46	A71894

Location, year, variety	Application				PHI	Deltamethrin	Report no.
	g ai/ha	g ai/hl	l/ha	No.	days	(mg/kg)	
					10	0.07	
Hamilton, New Zealand, 1978, Rye grass and clover	15	2.3	650	1	0 1 2 4 6	1.2 all fresh grass 1.2 1.3 0.7 0.5	A71894
Stelle, Germany, 1989, Prairie grass	5	1.7	300	1	28 214	<0.01 <0.01	A71894 A45977
Bornheim, Germany, 1989, Prairie grass	5	1.7	300	1	28 230	<0.01 <0.01	A71894 A45978
Gersthofen, Germany, 1989, Prairie grass	5	1.7	300	1	28 245	<0.01 <0.01	A71894 A45979
Kelsterbach, Germany, 1989, Prairie grass	5	1.7	300	1	29 58 263	<0.01 <0.01 <0.01	A71894 A45980
Hoopte, Germany, 1987, Standard GII (grass)	5	1.7	300	1	27 188 194	0.07 fresh grass 0.01 fresh grass <0.01 dried grass	A71894 A37011
Elstorf, Germany, 1987, Standard GII (grass)	5	1.7	300	1	30 185 191	0.07 fresh grass 0.01 fresh grass <0.01 dried grass	A71894 A37012
Bornheim, Germany, 1987, (grass)	5	1.7	300	1	208 228	<0.01 fresh grass <0.01 dried grass	A71894 A37013
Hattersheim, Germany, 1987, Hesa (grass)	5	1.7	300	1	210 217	<0.01 fresh grass <0.01 dried grass	A71894 A37014
Stelle, Germany, 1990, (grass)	14	4.2	340	1	0 14 28 53 56	0.65 fresh grass 0.06 fresh grass 0.01 fresh grass <0.01 fresh grass <0.01 dried grass	A71894 A49931
Bornheim, Germany, 1990, (grass)	15	4.2	367	1	0 21 28 54 59	0.29 fresh grass 0.02 fresh grass 0.02 fresh grass 0.02 fresh grass 0.07 dried grass	A71894 A49931
Gersthofen, Germany, 1990, (grass)	18	4.1	440	1	0 15 28 34 34	0.62 fresh grass 0.02 fresh grass <0.01 fresh grass <0.01 fresh grass <0.01 dried grass	A71894 A49931
Kelsterbach, Germany, 1990, (grass)	14	4.2	342	1	0 14 28 72 72	0.77 fresh grass 0.08 fresh grass <0.01 fresh grass <0.01 fresh grass <0.01 dried grass	A71894 A49931
Fodder peas							
Monchiet, France, 1992, Solara	6.25	3.1	200	1	48	<0.005 seeds	A71894
Torcé, France, 1992, Solara	6.25	3.1	200	1	58	0.011 seeds	A71894
Asnières en Montagne, France, 1992, Terese	6.25	3.1	200	1	51	<0.005 seeds	A71894

FATE OF RESIDUES IN STORAGE AND PROCESSING

In processing

Processing studies on apples, plums, tomatoes, olives, rice, maize, wheat, sorghum and rape seed (canola) were reported to the Meeting.

Apples. The fate of deltamethrin in processed apple commodities was studied by Brady (1999a) with Golden Delicious apples sprayed 3 times with deltamethrin (EC) at 190 g ai/ha at intervals of 7 days at a volume of 935 l/ha. The apples, harvested 21 days after the last application, were processed according to normal commercial procedures: washed with water, graded to remove bruised and insect-damaged fruit, then crushed using a hammer-mill to produce pulp. The pulp was heated to 40-50°C, enzyme added and pressed in an hydraulic press to separate juice from the wet pomace.

Analysis of samples was by method BP/01/98, by which individual deltamethrin isomers can be determined. Recoveries of deltamethrin, *trans*- and α-*R*-deltamethrin in the various fractions are tabulated below.

Table 105. Procedural recoveries from the analysis of deltamethrin, *trans*- and α-*R*-deltamethrin in apples, juice and wet pomace (Brady, 1999a).

Sample	Fortification (mg/kg)	Recovery (%)		
		Deltamethrin	*trans*-deltamethrin	α-*R*-deltamethrin
Whole fruit	0.05	99	104	99
Wet pomace	0.05	96	103	92
Juice	0.099	106	116	110

Table 106. Processing factors for deltamethrin on processing apples to wet pomace and juice (Brady, 1999a).

Sample	Residue (mg/kg)			Processing factor (total deltamethrins)
	Deltamethrin	*trans*-deltamethrin	α-*R*-deltamethrin	
Whole fruit	0.45, 0.51	0.09, 0.11	<0.05, <0.05	-
Wet pomace	2.6, 2.8	0.49, 0.52	0.11, 0.11	3.3/0.58 = 5.7
Juice	<0.05 (2)	<0.05 (2)	<0.05 (2)	<0.05/0.58 = <0.09

Plums. Brady (1999b) sprayed Stanley plums 3 times with deltamethrin (EC) at 250 g ai/ha at intervals of 7 days at a volume of 920-930 l/ha. The plums, picked 3 days after the last application, were processed according to normal commercial procedures. They were washed with water and graded to remove debris (leaves, stems etc), placed on trays and dried in an air-dryer at 68-79°C. The trays were periodically removed to assess progress. At the end of the drying the prunes had a moisture content of 19-24%.

Analysis of samples was by method BP/01/98 which determines deltamethrin and its isomers. Recoveries of deltamethrin, *trans*- and α-*R*-deltamethrin in whole fruit fortified at 0.05 mg/kg were 113, 118 and 108%, and for prunes fortified at 0.05 mg/kg 112, 117 and 107% respectively.

Table 107 Concentration of deltamethrin residues in plums and dried prunes (Brady, 1999b).

Sample	Residue (mg/kg)			Processing factor (total deltamethrins)
	Deltamethrin	*trans*-deltamethrin	α-*R*-deltamethrin	
Whole fruit	0.83, 0.93	0.16, 0.16	0.05, 0.05	-
Prunes	3.4, 3.4	0.34, 0.34	0.23, 0.23	3.97/1.09= 3.6

Tomatoes. In a trial with one control and one treated plot of 4 rows of plants each in Fresno, California, USA, an EC formulation of deltamethrin was applied six times as a foliar spray to Rio Grande tomatoes at 160 g ai/ha, application volume 186-191 l/ha, at 5-day intervals (Brady, 1999c). Fruit were picked one day after the last spray and delivered to the processing facility within 4 hours. Tomatoes were washed and juiced by crushing, heated to 99°C and filtered through an 8 mm screen to remove peel and seed (wet pomace). The resulting juice was stored in barrels. The juice was

concentrated to purée by vacuum evaporation until the natural tomato soluble solids (NTSS) were in the range 8-16% and the resulting purée canned. Some of the purée was condensed to paste (26% NTSS) using a vacuum kettle evaporator. Analysis of samples was by method BP/01/98. Recoveries from whole fruit fortified at 0.1 mg/kg were 102, 105 and 93% of deltamethrin, *trans*- and α-*R*-deltamethrin, and from purée at 0.1 mg/kg 100, 109 and 98% respectively.

Table 108. Residues of deltamethrin in tomatoes and their processed commodities (Brady, 1999c).

Sample	Residue (mg/kg)			
	Deltamethrin	*trans*-deltamethrin	α-*R*-deltamethrin	Total
Whole fruit	0.15, 0.32	<0.1, <0.1	<0.1, <0.1	0.15, 0.32
Purée	<0.1, <0.1	<0.1, <0.1	<0.1, <0.1	<0.1, <0.1
Paste	<0.1, <0.1	<0.1, <0.1	<0.1, <0.1	<0.1, <0.1

The processing factors (total deltamethrins) for purée and paste were <0.4

Olives. An EG formulation was applied to olives four times at growth stage BBCH 77-85 (70% fruits final size, advanced ripening/fruit coloration) at three different locations in Southern Europe (Klein and Martens, 2000a). The first three applications were at 37.3 g ai/ha and the fourth at 52.5 g ai/ha using motorised knapsack sprayers and plots of 179-294 m^2. The period from sampling to analysis by method DGM F01/97-0 was 525-542 days for all samples. Recoveries were 93 and 81% from olives fortified at 0.05 mg/kg; 99 and 114% from pomace at 0.05 mg/kg and 132% at 2.0 mg/kg, 96 and 95% from crude oil at 0.2 mg/kg, 71% at 0.6 mg/kg and 101% at 2.0 mg/kg; 95 and 94% from refined oil at 0.2 mg/kg and 88% at 2.0 mg/kg, 116 and 74% from processing water at 0.05 mg/kg and 95% at 0.2 mg/kg.

Table 109. Residues of deltamethrin and processing factors for olives and processed commodities (Klein and Martens, 2000a).

Location, year, variety	Application					PHI (days)	Deltamethrin[1] (mg/kg)	Processing factor
	Form	g ai/ha	g ai/hl	l/ha	No.			
Pau, Catalunia, Spain, 1997, Argudell	EG	38×3, 53	3.8×3, 5.3	1000	4	7	1.7 fruit 0.83 pomace <0.05 water/pressing 2.8 crude oil 2.5 refined oil	- 0.49 <0.03 1.6 1.5
Sommieres, Languedoc-Roussillon, France 1997, Picholine	EG	38×3, 53	3.8×3, 5.3	1000	4	7	1.3 fruit 0.58 pomace 0.39 water/pressing 2.0 crude oil 2.4 refined oil	- 0.45 0.3 1.5 1.8
Beaumes de Venise, Languedoc-Roussillon, France 1997, Verdale	EG	38×3, 53	3.8×3, 5.3	1000	4	7	0.67 fruit 0.45 pomace <0.05 water/pressing 0.96 crude oil 0.98 refined oil	- 0.67 <0.07 1.4 1.5

[1] total deltamethrins

Mean processing factors (total deltamethrins) were 0.54 for pomace, 0.13 for water/pressing, 1.5 for crude oil and 1.6 for refined oil.

Rice. Harvested Lemont grain was treated with an EC formulation of deltamethrin at a rate equivalent to 0.5 g ai/tonne (Pitts, 1993a). The grain was cleaned (the moisture content noted: 10.5%) and hulled to give hulls, mill by-product and brown rice. The brown rice was milled to produce bran and polished rice. Analysis of samples was by method HRAV-7B "Gas chromatographic determination of tralomethrin, cis-deltamethrin, trans-deltamethrin and alpha-R-deltamethrin in cotton seed and cotton seed fractions". Recoveries of deltamethrin and its isomers from the various fractions are shown in Table 110 and the results of the trial in Table 111.

Table 110. Procedural recoveries in the determination of deltamethrin, *trans*- and α-*R*-deltamethrin in rice and its processed commodities (Pitts, 1993a).

Sample	Fortification (mg/kg)	Recovery (%)		
		Deltamethrin	*trans*-deltamethrin	α-*R*-deltamethrin
Rough rice (paddy)	0.02	111	111	111
	10	107	105	108
Rice hulls	0.02	118	108	114
	10	77	70	82
Mill by-products	0.02	106	102	105
	10	73	70	75
Brown rice	0.02	88	82	91
	10	81	72	84
Rice bran	0.02	70	65	72
	10	90	84	92
Polished rice	0.02	110	110	118
	10	85	81	88

Table 111 Residues of deltamethrin and processing factors for rice and its processed commodities (Pitts, 1993a).

Sample	Residue (mg/kg)			Processing factor
	Deltamethrin	*trans*-deltamethrin	α-*R*-deltamethrin	(total deltamethrins)
Rough rice	0.31, 0.34	<0.02 (2)	<0.02 (2)	-
Rice hulls	1.6, 1.4	<0.02 (2)	<0.02 (2)	1.5/0.33 = 4.5
Mill by-products	0.07, 0.07	<0.02 (2)	<0.02 (2)	0.07/0.33 = 0.21
Brown rice	0.04, 0.05	<0.02 (2)	<0.02 (2)	0.05/0.33 = 0.15
Rice bran	0.51, 0.49	<0.02 (2)	0.04, 0.05	0.55/0.33 = 1.7
Polished rice	<0.02 (2)	<0.02 (2)	<0.02 (2)	<0.02/0.33 = <0.06

Maize. Molinari (1989) studied the effects of processing on residues of deltamethrin used as a stored grain protectant on maize. Maize grain was treated with an emulsifiable concentrate (0.27 and 1.24 g ai/tonne grain) formulation of deltamethrin before storage in horizontal granaries. Samples of maize were collected initially and after storage periods of 42, 91 and 182 days. Portions of the grain stored for 42 and 182 days were degermed (wet and dry milling). For the former the grain was sieved (cleaned grain + impurities), degermed by hand after soaking in water for 30 hours at 50°C (degermed maize), and the moisture content of the germ reduced to approximately 5% by drying at 70°C under vacuum for 10 hours. For dry milling, the maize was sieved (cleaned grain + impurities) and milled in a small-scale mill to obtain degermed maize and germ. Oil was extracted from dry germ with hexane by Soxhlet extraction and the solvent removed under vacuum. Analysis was by GLC with ECD. Recoveries from maize samples fortified at 0.2 mg/kg were 74 and 90%.

Table 112. Residues of deltamethrin and processing factors for maize and its wet-milled processed commodities (Molinari, 1989).

Sample	Deltamethrin residues (mg/kg)[1] and processing factors			
	0.27 g ai/tonne	Processing factor	1.24 g ai/tonne	Processing factor
42 days storage				
Received grain	0.263	-	0.583	-
Cleaned grain	0.295	1.1	0.485	0.83
Impurities (fine)	3.73	14	16.8	29
Maceration water	0.012	0.046	0.034	0.06
Maize milled after water bath	0.017	0.064	0.042	0.07
Degermed maize	0.016	0.061	0.044	0.07
Germ	0.005	0.019	0.022	0.04
Oil	0.010	0.038	0.599	1.03

Sample	Deltamethrin residues (mg/kg)[1] and processing factors			
	0.27 g ai/tonne	Processing factor	1.24 g ai/tonne	Processing factor
182 days storage				
Received grain	0.111		0.362	-
Cleaned grain	0.119	1.07	0.305	0.84
Impurities (fine)	3.82	34	13.67	38
Maceration water	0.009	0.08	0.056	0.15
Maize milled after water bath	0.019	0.17	0.044	0.12
Degermed maize	0.014	0.13	0.033	0.09
Germ	0.000	0	0.000	0
Oil	0.143	1.3	0.455	1.3

[1] total deltamethrins

The mean processing factors for germ and oil were 0.03 and 0.53 respectively for grain processed after 42 days and 0 and 1.3 after 182 days.

Table 113. Residues of deltamethrin and processing factors for maize (treated and stored for 182 days before processing) and its dry-milled processed commodities (Molinari, 1989).

Sample	Deltamethrin residues (mg/kg)[1] and processing factors			
	0.27 g ai/tonne	Processing factor	1.24 g ai/tonne	Processing factor
Received grain	0.053	-	0.346	-
Cleaned grain	0.044	0.83	0.185	0.53
Impurities (fine)	2.14	40	11.52	33
Degermed maize	0.052	0.98	0.195	0.56
Germ	0.025	0.47	0.063	0.18
Oil	1.486	28	3.00	8.7

[1] total deltamethrins

The mean processing factors germ and oil were 0.32 and 18 respectively.

Wheat. The effect of processing on residues of deltamethrin in wheat was studied by Pitts (1993b). Harvested Florida 302 grain was treated with an EC formulation of deltamethrin at a rate equivalent to 0.5 g ai/tonne. 31 kg of grain was cleaned by aspiration and sieving and the moisture content adjusted to 16% with water. The milling process consisted of four break and reduction steps. In the first break the corrugated rollers were set to open the kernels without excessive damaging or crushing of the bran, the second and third removed and the fourth removed the remainder. Milled material was passed through 730, 390, 240 and 132 micron sieves. That retained by the 730 micron sieve is bran and that retained by the 390 and 240 micron sieves middlings. A sample of the middlings is reduced four times using a smooth roller mill and the milled material with that retained by the 390 and 240 micron sieves is shorts. The material through the 240 and 132 micron sieves is flour. Analysis was by method HRAV-7B, and recoveries of deltamethrin and its isomers are shown in Table 114.

Table 114. Procedural recoveries in the determination of deltamethrin, *trans*- and α-*R*-deltamethrin in wheat and its processed commodities (Pitts, 1993b).

Sample	Fortification, mg/kg	Recovery (%)		
		Deltamethrin	*trans*-deltamethrin	α-*R*-deltamethrin
Grain	0.02	116, 98	113, 95	119, 102
	0.5	94, 83	86, 76	95, 85
	10	78, 77	73, 71	82, 81
Bran	0.02	85, 111	82, 112	94, 111
	0.5	112, 97	110, 101	112, 99
	10	97, 99	97, 101	98, 101
Flour	0.02	100, 113, 99	99, 114, 98	98, 113, 97
	0.5	109, 111	109, 111	110, 110
	10	93, 115	93, 117	93, 118
Middlings	0.02	99, 107	87, 98	101, 110

Sample	Fortification, mg/kg	Recovery (%)		
		Deltamethrin	*trans*-deltamethrin	α-*R*-deltamethrin
	0.5	89, 101	83, 97	92, 102
	10	97, 95	93, 89	100, 96
Shorts	0.02	109, 121	99, 111	111, 122
	0.5	87, 96	84, 89	85, 96
	10	91, 86	82, 86	93, 88

Table 115. Residues of deltamethrin and processing factors for wheat and its milled commodities (Pitts, 1993b).

Sample	Residue (mg/kg)			Mean processing factor (total deltamethrins)
	Deltamethrin	*trans*-deltamethrin	α-*R*-deltamethrin	
Grain	0.36, 0.37	<0.02 (2)	<0.02 (2)	-
Bran	0.95, 0.87	<0.02 (2)	0.04 (2)	2.6
Flour	<0.02 (2)	<0.02 (2)	<0.02 (2)	<0.06
Middlings	0.26, 0.25	<0.02 (2)	<0.02 (2)	0.7
Shorts	0.22, 0.27	<0.02 (2)	0.04, 0.05	0.79

The disposition of deltamethrin in wheat and its commodities processed by pilot and commercial mills was reported by Shield (1991). ASW grade wheat was treated twice with an EC formulation of deltamethrin (also containing chlorpyrifos-methyl) at nominal rates of 0.25 g ai/tonne and 0.5 g ai/tonne. Each treatment was of approximately 200 tonnes of grain. The residues from the two treatments were 0.19 and 0.62 mg/kg respectively. Three one-tonne lots of wheat were shipped to a pilot flour-mill (throughput 660 kg wheat/hour). The wheat and milled commodities were analysed by two different laboratories and the results shown in Table 116 are averages of the individual laboratory results. Deltamethrin residues were also measured in cooked products prepared from the milled commodities. The results are for total deltamethrins.

Table 116. Residues of deltamethrin in wheat, milled wheat commodities and cooked products with processing factors, pilot-scale milling (Shield, 1991).

Sample	0.25 g ai/tonne				0.5 g ai/tonne			
	8 weeks		18 weeks		8 weeks		18 weeks	
	(mg/kg)	PF	(mg/kg)	PF	(mg/kg)	PF	(mg/kg)	PF
Wheat [1]	0.17	-	0.16	-	0.40	-	0.35	-
Milled products								
Bran	0.62	3.6	0.65	4.1	1.65	4.1	1.47	4.2
Germ	0.26	1.5	0.22	1.4	0.61	1.5	0.58	1.7
Flour	0.04	0.23	0.04	0.25	0.10	0.25	0.12	0.34
Cooked products								
Flour	0.04	0.24	0.02	0.13	0.10	0.25	0.11	0.31
Wholemeal	0.10	0.59	0.15	0.94	0.42	1.1	0.41	1.2
White bread	0.03	0.18	0.02	0.13	0.06	0.15	0.04	0.11
Wholemeal bread	0.07	0.41	0.04	0.25	0.24	0.6	0.15	0.43
Flat bread	0.08	0.47	0.07	0.44	0.20	0.5	0.20	0.57
Steamed bread	0.02	0.12	0.02	0.13	0.06	0.15	0.06	0.17
Yellow alkaline noodles	0.02	0.12	0.02	0.13	0.09	0.23	0.07	0.2
White noodles	0.02	0.12	0.02	0.13	0.06	0.15	0.04	0.11

[1] cleaned wheat to first break sampled during milling run

Twenty five to 50-tonne lots of the treated wheat were processed into bran, germ and flour at two different commercial milling operations. Samples of wheat and its processed commodities were analysed by two different laboratories (Table 117). Analytical recoveries were 104% from wheat fortified at 0.4 mg/kg, 111% from bran at 0.8 mg/kg, 98% from germ at 0.8 mg/kg and 101% from flour at 0.4 mg/kg.

Table 117. Residues of deltamethrin in wheat and its processed commodities with processing factors from commercial-scale milling (Shield, 1991).

Sample	0.25 g ai/tonne				0.5 g ai/tonne			
	10 weeks		15 weeks		10 weeks		15 weeks	
	(mg/kg)	PF	(mg/kg)	PF	(mg/kg)	PF	(mg/kg)	PF
Wheat (cleaned)	0.15	-	0.14	-	0.34	-	0.37	-
Bran	0.42	2.8	0.41	2.9	0.83	2.4	1.1	3
Germ	0.14	0.93	0.11	0.79	0.34	1	0.33	0.9
Flour, straight run	0.1	0.67	0.05	0.36	0.09	0.26	0.15	0.4
Flour, last reduction	0.04	0.27	0.1	0.7	0.15	0.44	0.28	0.76
Wheat meal			0.11	0.79			0.32	0.86

Sorghum. Pitts (1993c) treated harvested Funks 1492 grain with an EC formulation of deltamethrin at a rate equivalent to 0.5 g ai/tonne. For wet milling 34 kg grain was aspirated and sieved before being steeped at 50°C in water to which sodium bisulfite and lactic acid had been added. After approximately 44 hours the grain was wet-milled and the germ, bran and fine bran/coarse gluten starch separated by sieving. Separation of the starch from the gluten was by centrifugation. For dry milling 34 kg grain was aspirated and screened, abrasively milled to remove most of the bran and grits and the remaining decorticated grain ground to flour. Analysis of samples was by method HRAV-7B and the recoveries of deltamethrin and its isomers are shown in Table 118 and the trial results in Table 119.

Table 118. Procedural recoveries from the determination of deltamethrin, *trans*- and α-*R*-deltamethrin in sorghum grain and its processed commodities (Pitts, 1993c).

Sample	Fortification (mg/kg)	Recovery (%)		
		Deltamethrin	*trans*-deltamethrin	α-*R*-deltamethrin
Grain	0.02	85, 99	87, 88	87, 100
	10	95, 91	97, 97	98, 92
Flour	0.02	96	98	105
	10	92	91	92
Starch	0.02	109	97	100
	10	89	89	92

Table 119. Residues of deltamethrin in sorghum and its milled commodities with processing factors (Pitts, 1993c).

Sample	Residue (mg/kg)			Processing factor
	Deltamethrin	*trans*-deltamethrin	α-*R*-deltamethrin	
Grain (dry milling)	0.35, 0.37	<0.02 (2)	<0.02 (2)	-
Flour (dry milling)	0.12, 0.12	<0.02 (2)	<0.02 (2)	0.12/0.36 = 0.33
Grain (wet milling)	0.42, 0.36	<0.02 (2)	<0.02 (2)	-
Starch (wet milling)	<0.02 (2)	<0.02 (2)	<0.02 (2)	<0.02/0.39 = <0.05

Oilseed rape (canola). Foliar sprays of deltamethrin were applied twice at 30 g ai/ha at Indian Head, Saskatchewan, Canada, with harvest 7 days later (Cole and Netzband, 2000). For processing, the seeds were cleaned using aspiration to remove fine particles, then sieved in a two-screen cleaner to separate small and large foreign particles. The whole seed was flaked in a flaking roll (setting 4-5 mm) and the flakes heated to 82-99°C and pressed to release the crude oil. Additional oil was extracted from the presscake with hexane. The crude oil and hexane were separated and the residual hexane removed from the crude oil by heating at 72-90°C. The crude oil was treated with phosphoric acid before refining. The longest interval between sampling and analysis, during which the samples were stored frozen, was 266 days. Residues of deltamethrin and its isomers were determined by method BP/01/98 (Table 120).

Table 120. Procedural recoveries from the determination of deltamethrin, *trans*- and α-*R*-deltamethrin in rape seed and its processed commodities (Cole and Netzband, 2000).

Sample	Fortification	Recovery (%)		
		Deltamethrin	*trans*-deltamethrin	α-*R*-deltamethrin
Seed	0.02	80, 76	75, 80	77, 68
Meal	0.02	112	104	114
Oil	0.05	88	83	71

Table 121. Residues of deltamethrin in rape seed and its processed commodities (Cole and Netzband, 2000).

Sample	Residue (mg/kg)		
	Deltamethrin	*trans*-deltamethrin	α-*R*-deltamethrin
Seed (field)	0.025, 0.028, 0.025	<0.02 (3)	<0.02 (3)
Seed (processing)	0.027, 0.031, 0.025	<0.02 (3)	<0.02 (3)
Meal	<0.02 (3)	<0.02 (3)	<0.02 (3)
Refined oil	<0.02 (3)	<0.02 (3)	<0.02 (3)

The lack of significant residues precludes the estimation of processing factors, but they are less than 1.

Residues in the edible portions of food commodities

No additional information.

RESIDUES IN ANIMAL COMMODITIES

Direct animal treatments

The use of deltamethrin as a direct animal treatment has been considered by JECFA.

Farm animal feeding studies

Feeding study on dairy cattle

It is noted that tralomethrin is rapidly converted to deltamethrin and that the metabolism of deltamethrin then proceeds as usual.

Lactating cows. Akhtar *et al.* (1992) fed dairy cows deltamethrin at the equivalent of 2 ppm (28.8 mg daily) or 10 ppm (140 mg daily) in the feed for 28 days. There were 3 animals per dose group with one control. The dose was administered by feeding cows 200 g of treated grain and the rates calculated on the basis of an average feed intake of 14.4 kg. The cows were milked twice daily and samples of milk collected at intervals. A single cow from each group was slaughtered twenty-four hours after receiving the final dose, and the remaining two cows slaughtered 4 or 9 days later. Samples of fore- and hind-quarter muscle, subcutaneous and renal fat, liver and kidney collected at slaughter and milk were analysed for total deltamethrins.

Residues in the kidneys were not determined because of difficulties with the analytical method, and in muscle and liver were below the LOQ of 0.03 mg/kg at both feed levels.

Table 122. Total deltamethrin isomers in the fat and milk of lactating dairy cows fed with deltamethrin for 28 consecutive days (Akhtar *et al.,* 1992).

Sample	Days after start of feeding [1]	Residue (mg/kg) [2]		
		Control	2 ppm	10 ppm
Subcutaneous fat	29 (1)		0.042	0.13
	32 (4)		0.037	0.089
	37 (9)		0.027	0.081
Renal fat	29 (1)		0.046	0.27
	32 (4)		0.036	0.21
	37 (9)		0.037	0.13
Milk				
	-1	ND	ND	ND
	1		<0.001	<0.001-0.005
	2		<0.001	0.008-0.015
	3		<0.001	0.008-0.035
	4	ND	0.007-0.012	0.011-0.053
	10		0.005-0.017	0.024-0.038
	11		0.006-0.007	0.021-0.030
	18		0.009-0.018	0.020-0.038
	25		<0.001-0.003	0.021-0.045
	Dosing ceased 28		<0.004-0.016	0.024-0.035
	29 (1)		0.007-0.009	0.027-0.031
	30 (2)		<0.001	0.007-0.010
	31 (3)		<0.001	0.005
	32 (4)		<0.001	<0.001
	33 (5)		<0.001	<0.001
	34 (6)		<0.001	<0.001

[1] figures in parentheses are days after last dose
[2] corrected for analytical recoveries

In another study groups of 3 lactating Holstein dairy cattle (462-718 kg bw) were dosed by balling gun with a 1:1 mixture of tralomethrin and deltamethrin at levels nominally equivalent to 2, 6 and 20 ppm, 36, 108 and 360 mg ai/capsule respectively in the diet for 28 days (Singh, 1988). The average feed consumption (hay + concentrate) before dosing was 17.8 kg per day. Doses, calculated from the average consumption figure, were administered in gelatin capsules after the morning milking. Daily composite milk samples were collected from each cow, with proportionate quantities of morning and evening milk mixed. Samples of milk from days 21 and 28 were separated into fat and skimmed milk. Cows from each group were slaughtered twenty-four hours after the last dose. Samples of fore- and hind-quarter muscle, composite omental, renal and peripheral fat, liver and kidney, and milk were analysed.

Table 123. Residues of deltamethrin in the tissues of lactating dairy cows orally dosed with 1:1 mixtures of tralomethrin and deltamethrin for 28 consecutive days (Singh, 1988).

Dose (ppm)	Combined deltamethrin and *trans*-deltamethrin (mg/kg)				
	Fat	Kidney	Liver	Muscle (hindquarter)	Muscle (forequarter)
2	0.04, 0.02, 0.01	<0.01 (3)	<0.01 (3)	0.01, <0.01 (2)	<0.01 (3)
6	0.01, 0.02, 0.02	<0.01 (3)	<0.01 (3)	<0.01 (3)	<0.01 (3)
20	0.01, 0.02, 0.03	<0.01 (3)	<0.01 (3)	<0.01 (3)	0.01 (2), <0.01

Table 124. Residues of deltamethrin and tralomethrin in the milk of lactating dairy cows orally dosed with 1:1 mixtures of tralomethrin and deltamethrin for 28 consecutive days (Singh, 1988).

Sampling (days)	Combined deltamethrin and *trans*-deltamethrin (mg/kg)					
	2 ppm		6 ppm		20 ppm	
	Deltamethrin	Tralomethrin	Deltamethrin	Tralomethrin	Deltamethrin	Tralomethrin
0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Sampling (days)	Combined deltamethrin and *trans*-deltamethrin (mg/kg)					
	2 ppm		6 ppm		20 ppm	
	Deltamethrin	Tralomethrin	Deltamethrin	Tralomethrin	Deltamethrin	Tralomethrin
1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1PM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
3	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
3AM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
3PM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
10	0.01	0.01	<0.01	<0.01	0.02	0.02
14	0.01	0.02	<0.01	<0.01	0.01	0.01
17	0.01	0.02	<0.01	0.01	<0.01	0.01
21	0.01	0.02	<0.01	<0.01	0.01	0.01
24	0.01	0.01	<0.01	<0.01	<0.01	0.01
28	0.01	0.01	<0.01	<0.01	<0.01	0.01
21 skimmed milk	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
28 skimmed milk	0.01	0.02	<0.01	0.01	<0.01	<0.01
21 milk fat	0.04	0.05	0.03	0.03	0.02	0.02
28 milk fat	0.04	0.05	0.03	0.04	0.02	0.02

Residues of deltamethrin were highest in the low-dose group and in all groups much lower than in the 10 ppm group in the study by Akhtar *et al.* (1992). It was not possible to verify the administered doses.

Pigs. Marti-Mestres *et al.* (1993) fed 3 female and 3 male Landrace pigs a diet that included flour made from deltamethrin-treated grain (0.95 ± 0.07 mg/kg, 70% of the diet giving a feeding level of 0.67 ± 0.05 ppm) for 130-141 days. The average weights of the female and male pigs at the start of the study were 25 and 27 kg respectively and at slaughter 100 kg. Residues of deltamethrin were below the LOQ of 0.03 mg/kg for muscle and 0.01 mg/kg for kidney and liver for all animals and below the LOQ of 0.03 mg/kg in fat of the male pigs. The mean residue in the fat of the sows was 0.03 ± 0.01 mg/kg.

Chickens. Poulet de chair ja 657 chickens were fed a diet for a maximum of 70 days that included flour prepared from wheat treated at a nominal rate of 1.2 g ai/tonne and on milling contained deltamethrin residues at *ca.* 1 mg/kg (Marti-Mestres *et al.,* 1995). The flour was fed at 70% of the diet giving an approximate feeding rate of 0.7 ppm. Groups of 10 birds were killed after 14, 28, 49 and 70 days with further groups on deltamethrin-free feed killed after 3, 7, 14 and 21 days. Residues in muscle, fat and liver of all groups were below the LOQ of 0.01 mg/kg, and in skin average residues were 0.008 ± 0.001 to 0.01 ± 0.001 mg/kg for groups killed during the 70 days of treatment. Feathers from birds killed after 28 and 49 days contained residues of 0.015 ± 0.005 mg/kg and 0.04 ± 0.005 mg/kg suggesting that residues in the skin were from contamination of the feathers with treated flour.

Laying hens. In the same study laying Isabrown hens (*ca.* 2 kg bw) were fed deltamethrin in the diet at 0.7 ppm for 20 weeks. Residues were not detected (<0.002 mg/kg) in eggs collected during the feeding period.

In a separate study groups of 20 White Leghorn hens (1.5 kg bw) were dosed with tralomethrin and deltamethrin at nominal levels equivalent to a combined dose of 2, 6 and 20 ppm in the diet for 28 days (Fletcher and Helsten, 1994). The average feed consumption before dosing was 124-140 g per day. Doses, calculated from the average consumption figure, were administered in separate gelatin capsules for the tralomethrin and deltamethrin daily doses. Eggs were collected twice daily and separated into whites and yolks and into 4 sub-groups for each treatment group. Hens from each dose group were killed twenty-four hours after the last dose. Samples of thigh and breast muscle (approximately equal portions), fat (equal portions of abdominal and subcutaneous), liver and kidney collected at slaughter and reconstituted eggs (68% white: 32% yolk) were analysed by GC-ECD (tralomethrin is converted to deltamethrin by the heat of the injection port of the gas chromatograph).

Table 125. Residues of deltamethrin in the tissues and eggs of laying hens orally dosed with 1:1 mixtures of tralomethrin and deltamethrin for 28 consecutive days (Fletcher and Helsten, 1994).

Sample	Residue (mg/kg)		
	2 ppm	6 ppm	20 ppm
Fat	<0.05 (4)	0.26, 0.13, 0.08, 0.09	0.53, 0.34, 0.32, 0.49
Liver	<0.02 (4)	<0.02 (4)	<0.02 (4)
Muscle	<0.02 (4)	<0.02 (4)	<0.02 (4)
Eggs			
1 day	<0.015 (3)	<0.015 (3)	<0.015 (3)
2 days	<0.015 (3)	<0.015 (3)	<0.015 (3)
4 days	<0.015 (3)	<0.015 (3)	<0.015 (3)
7 days	<0.015 (3)	<0.015 (2), 0.018	0.023, 0.017, 0.017
10 days	<0.015 (3)	<0.015 (3)	0.029, 0.022, 0.031
14 days	<0.015 (3)	<0.015 (3)	0.025, 0.027
21 days	<0.015 (3)	<0.015 (3)	0.037, 0.034, 0.027
28 days	<0.015 (3)	<0.015 (3)	0.034, 0.021, 0.030

RESIDUES IN FOOD IN COMMERCE OR AT CONSUMPTION

Information was provided by the governments of Australia and Poland.

Deltamethrin was included in the 1996 Australian Market Basket Survey in which 77 foods were analysed for pesticide residues (Hardy, 1998). The estimated daily dietary intakes were <0.2% of the ADI of 0.01 mg/kg bw for both mean and 95th percentile energy diets for the various populations studied (adult males and females, boys and girls aged 12 years, toddlers aged 2 years and infants aged 9 months).

Deltamethrin was included in the targeted enforcement monitoring programmes in the state of Victoria, Australia. Residues of deltamethrin were not detected in lettuce (40 samples) but were detected in broccoli (LOQ 0.001-0.01 mg/kg; 1 of 21 samples) and silverbeet (1 of 8 samples) in 1987-2001, with the highest residue at 0.02 mg/kg.

In monitoring in Poland for the years 1999 and 2000 residues of deltamethrin were not detected in 220 samples of cabbage (LOQ 0.05 mg/kg), 30 samples of raspberry (LOQ 0.04 mg/kg), 208 samples of wheat grain (LOQ 0.05 mg/kg) and 148 samples of rye grain (LOQ 0.05 mg/kg).

NATIONAL MAXIMUM RESIDUE LIMITS

The residue is defined as the parent compound in Australia, the countries of the EU and the USA, the only countries for which this information was provided. The Meeting was informed that the following national MRLs had been established.

Country	Commodity	MRL (mg/kg)
Australia	Brassica (cole or cabbage) vegetables, head cabbages, flowerhead brassicas	0.05*
(deltamethrin)	Cattle, edible offal of, fruiting vegetables other than cucurbits, goat meat (in the fat), goat, edible offal of, legume vegetables, oilseed, pig meat (in the fat), pulses, lupin (dry), sheep meat (in the fat), sheep, edible offal of, sweet corn (kernels)	0.1
	Goat milk (in the fat), sheep milk (in the fat)	0.2
	Cattle meat (in the fat), cattle milk, (in the fat)	0.5
	Cereal grains	2
	Wheat germ	3

Country	Commodity	MRL (mg/kg)
	Wheat bran, unprocessed	5
	Aubergine (egg plant), cauliflower, cucumber, garlic, tomato	0.03
	Peach	0.04
	Broccoli, rice, citrus fruit, cotton seed, cucurbits with inedible peel, eggs, fat (in meat, preparations of meat, offal and fat), fungi, kohlrabi, mustard seed, other bulb vegetables, other oil seeds, other stem vegetables, potato (early), poultry skin + fat, root and tuber vegetables, shelled fresh eggs, soya bean, strawberry, sweet corn, tree nuts, watercress, wild berries and wild fruit, witloof, apricot, artichoke, banana, cacao beans, kiwi fruit, nectarine, plum, strawberry	0.05
	Citrus	0.1
	Peanut, sorghum	0.5
	Maize	1.0
	Beans (with and without pods), bilberry, cranberry, currants (red, black and white), gooseberry, leek, solanaceae	0.2
	Blackberry, dewberry, herbs, leafy Brassica, lettuce and similar, loganberry, potato (ware), raspberry, spinach and similar	0.5
	Cereals, pulses	1
	Hops, tea	5
	Currants, gooseberries, solanaceae, beans with pods (fresh), leek	0.2
	Blackberries, raspberries, leafy Brassica, lettuce and similar, spinach and similar, fresh herbs, ware potatoes	0.5
	Pulses, cereals	1
	Raw coffee	2
	Tea, hops	5
	Meat of poultry	0.05* (fat)
	Other food of plant origin	0.05*
	Cabbage, chicory, Chinese cabbage, endive, grape, green garden pea, green soya bean, kale, komatsuma, lettuce, pot herb mustard (brassica japonica), spinach	0.5
	Orange	1
	Coffee	2
	Hops	5
	Tea	10
	Olives	0.1*
	Currants (red, black, white), gooseberries, solanaceae, beans with pods, leek	0.2
	Blackberries, raspberries, leafy Brassica, lettuce and similar, spinach and similar, herbs, ware potatoes, wholemeal	0.5
	Pulses, cereals	1
	Bran	2
	Tea, hops	5
	Meat of poultry	0.05* (fat)
	Others	0.05*
	Pome fruit, stone fruit, sugar beet, red beet, rape seed	0.1
	Berries and other small fruit, vegetables, except others listed	0.2
	Leafy vegetables, stalk and stem vegetables	0.5
	Cereal grains	1
	Tea	5
	Cotton seed	0.04
	Cotton seed oil	0.2
	Tomato	0.2

Country	Commodity	MRL (mg/kg)
	Eggs, pig, edible offal of, poultry meat (in the fat), poultry, edible offal of,	0.01*
Brazil	Apple, cacao, plum, milk	0.02
EU (deltamethrin)	Artichoke, asparagus, avocado, banana, cardoons, celery, cucurbits-edible peel, date, fennel, fig, flowering brassica, garlic, grape, head Brassica, kiwi fruit, kumquats, olive, peanut, peas (with and without pods), pome fruit, poppy seed, shallot, spring onion, stone fruit, barley, broad bean, buckwheat, corn, cotton seed, garden pea, garlic, green kidney bean, kidney bean, loquat, onion, welsh onion, other beans, other cereal grain, other oil seeds, peach, peanut, quince, rape seed, rice, rye, safflower seed, sesame seed, shallot, soya bean, sunflower seed, wheat	0.1
Germany (deltamethrin)	Pome fruit, stone fruit, grapes, garlic, onions, shallots, spring onions, cucurbits (edible peel), flowering brassicas, head Brassica, peas with pods (fresh), globe artichokes, rape seed, olives	0.1
Japan	Apple, aubergine (egg plant), broccoli, cauliflower, cherry, cucumber, Japanese pear, other mushroom, pear, pumpkin (inc squash), shitake mushroom, sweet pepper, tomato, watermelon	0.2
Netherlands	Pome fruit, stone fruit, table and wine grapes, garlic, onions, shallots, spring onions, cucurbits (edible peel), flowering Brassica, head Brassica, peas with pods, globe artichokes, rape seed, meal	0.1
Poland	Citrus fruit, root and tuber vegetables (except sugar and red beet), potato, mushrooms, poultry meat, eggs	0.05
USA (deltamethrin)	Artichoke	0.5

APPRAISAL

The Meeting received extensive information on deltamethrin [(*S*)-α-cyano-3-phenoxybenzyl (1*R*,3*R*)-3-(2,2-dibromovinyl)-2,2-dimethylcyclopropanecarboxylate] metabolism and environmental fate, methods of residue analysis, freezer storage stability, national registered use patterns, supervised residue trials, farm animal feeding studies, fate of residues in processing and national MRLs.

The 2000 JMPR established an ADI and acute RfD for deltamethrin of 0.01 mg/kg bw/day and 0.05 mg/kg bw, respectively.

Deltamethrin is the [1*R*,*cis*; α-*S*]-isomer of 8 stereoisomeric esters derived from esterification of the dibromo analogue of chrysanthemic acid, 2,2-dimethyl-3-(2,2-dibromovinyl) cyclopropanecarboxylic acid (Br_2CA) with α-cyano-3-phenoxybenzyl alcohol.

The following abbreviations are used for the metabolites discussed below:

α-*R*-deltamethrin = [1*R*-[1α(*R**),3α]]-α-cyano-3-phenoxybenzyl 3-(2,2-dibromovinyl)-2,2-dimethylcyclopropanecarboxylate

trans-deltamethrin = [1*R*-[1α(*S**),3β]]-α-cyano-3-phenoxybenzyl 3-(2,2-dibromovinyl)-2,2-dimethylcyclopropanecarboxylate

*m*PB aldehyde = 3-phenoxybenzaldehyde

*m*PB acid = 3-phenoxybenzoic acid

(*cis*) Br_2CA = (1*R*-*cis*)-3-(2,2-dibromovinyl)-2,2-dimethy**lc**yclopropanecarboxylic acid

Animal metabolism

Radiolabelled deltamethrin preparations separately ^{14}C-labelled at the benzylic methine, *gem*-dimethyl and cyano positions, were used in the metabolism and environmental studies. The metabolism of laboratory animals was qualitatively the same as for farm animals.

Lactating cows were orally dosed with -*gem*-dimethyl-[^{14}C]deltamethrin or benzyl-[^{14}C]deltamethrin at 10 mg/kg bw for 3 consecutive days. The majority of the radioactive residue was excreted unchanged in the faeces with 36-43% eliminated within 24 hours of the last dose. Only 0.4-1.6% of the administered ^{14}C was secreted in milk. "Total deltamethrin" (deltamethrin, α-*R*- and *trans*–deltamethrin were not individually resolved) was the major identifiable product in milk (0.1-0.14 mg/kg). The radiocarbon content of tissues, reported in deltamethrin equivalents was highest in liver (2.2-3.2 mg/kg), kidney (1.3-2.2 mg/kg), udder (0.4-0.6 mg/kg) and fat (0.28-0.56 mg/kg) and with low levels (<0.2 mg/kg) present in other tissues. Deltamethrins and their hydrolysis products, formed from hydrolysis of the ester, were the main components of the ^{14}C in liver and kidney (each 23-35%) while "total deltamethrin" was the major component of the ^{14}C residue in fat (60-90%).

When laying hens were orally dosed with [^{14}C]-*gem*-dimethyl-deltamethrin or [^{14}C]-benzyl-deltamethrin for 3 consecutive days at 7.5 mg/hen/day, the majority of the dose (*ca.* 83%) was eliminated in the excreta within 24 hours of the last dose. Radioactive residues in eggs reached a peak at 48 hours after the last dose at 0.2 mg/kg deltamethrin equivalents in albumin and 0.6 mg/kg in yolk. Radioactive residues in tissues of birds slaughtered at 18 hours after the last dose were highest in liver (4.0 mg/kg deltamethrin equivalents) and kidney (6.9 mg/kg) with low levels observed in other tissues. Maximum ^{14}C residues in abdominal fat were 0.66 mg/kg while those in muscle were 0.21 mg/kg, both expressed in deltamethrin equivalents. The major radiolabelled compound identified in eggs, liver and kidney was "total deltamethrin" (deltamethrin, α-*R*- and *trans*–deltamethrin were not individually resolved).

Plant metabolism

The Meeting received information on the fate of deltamethrin after foliar application to cotton, maize, apple and tomato.

Cotton plants were treated with [^{14}C]deltamethrin as a foliar, soil or hydroponic treatment to study root uptake and translocation. Although there was significant root uptake, translocation to other parts of the plant was very limited. Application to single leaves confirmed that translocation is limited. When ^{14}C- deltamethrin labelled at the dibromovinyl, benzyl, and cyano carbons was applied to the leaves of cotton plants grown in a glasshouse or in the field. Conversion of deltamethrin to the *trans*-deltamethrin occurred via photochemical reactions such that after 6 weeks the *trans*:*cis* ratio in leaves was 0.4:1 for glasshouse grown plants. Degradation of deltamethrin was greater under field conditions than in glasshouse experiments.

Cotton plants were grown outdoors and were treated with either ^{14}C-benzyl- or ^{14}C-*gem*-dimethyl-deltamethrin. Deltamethrin and two of its isomers (*trans*- and α-*R*-deltamethrin) were the primary components of the radioactivity detected in leaves (80 –85% at day 4; 65 – 75% ^{14}C at day 10). Only low levels of radioactivity were detected in cottonseed consistent with limited translocation.

The metabolism of ^{14}C-*gem*-dimethyl- and ^{14}C-benzyl-deltamethrin was also studied in field corn. In forage, foliage and husk at 28 and 42 days after application, 80 – 100% of ^{14}C residues were identified as deltamethrin and its isomers. Minor metabolites were generally present at ≤0.01 mg/kg. Grain and cob contained only low levels of radioactivity (≤0.06 mg/kg deltamethrin equivalents). A large part of the radioactivity in grain could not be extracted.

The metabolism of ^{14}C-*gem*-dimethyl- and ^{14}C-benzyl-deltamethrin was studied in apples. "Total deltamethrins" was the major component of the radioactivity detected at 14 to 42 days after application accounting for 92 – 100% of the ^{14}C. As regards the isomeric composition of the "total deltamethrins" residue, deltamethrin predominated (59-71%) with varying amounts of α-*R*- (19-34%)

and *trans*–deltamethrin (5.8-19%) also being present. Several minor components were present at <0.01 mg/kg deltamethrin equivalents and at <10% of the ^{14}C.

The metabolism of deltamethrin was investigated in tomatoes under greenhouse conditions, tomato plants and individual fruit on plants with ^{14}C-*gem*-dimethyl-deltamethrin or ^{14}C-benzyl-deltamethrin foliar spray and by direct application to the fruits. For both methods of application, 79 – 93% of the ^{14}C in fruit was present as "total deltamethrins" (deltamethrin, α-*R*- and *trans*–deltamethrin were not resolved) at 4-28 days after application.

Metabolism studies in tomatoes, apples, corn and cotton demonstrated that deltamethrin and its isomers (*trans*- and α-*R*-deltamethrin) were poorly degraded and that the degradation pattern was similar in all crops. The major identified products of deltamethrin metabolism in plants are analogous to those in mammals but differed in the conjugating moieties involved. The proposed degradation pathway consists of isomerization, hydrolysis, ester cleavage, reduction, oxidation and hydroxylation. Deltamethrin is not systemic, with only limited translocation in plants.

Environmental fate

Soil

The half-lives for deltamethrin degradation under aerobic test conditions was estimated to be 22-25 days. Degradation occurred via ester hydrolysis followed by oxidation and mineralisation to $^{14}CO_2$.

The half-life for deltamethrin degradation under anaerobic test conditions was estimated to be 32-36 days. Anaerobic degradation occurred via an epimerisation of the pyrethroid moiety followed by ester cleavage, oxidation and mineralisation in the form of $^{14}CO_2$ and its incorporation into the soil biomass.

The adsorption constants of deltamethrin were determined in four US standard soils ranging from sandy loam to silty clay loam. The adsorption and desorption characteristics of deltamethrin did not vary much between soils and based on the log K_{OC} values the compound can be considered as being immobile.

In confined rotational crop studies, no significant residues of deltamethrin (<0.01 mg/kg) were found in any crop material. It is concluded that succeeding or rotational crops are unlikely to contain significant residues of deltamethrin.

The degradation of deltamethrin under field conditions was studied at four different locations in Germany. The degradation half-lives for soil ranged from 17 to 29 days.

The dissipation and mobility of deltamethrin and its isomers as well as Br_2CA was studied in corn and cotton fields. The only compounds detected in soil were deltamethrin and α-*R*-deltamethrin, the later only in a few samples and at very low levels. Deltamethrin did not move down the soil profile. The half-life for deltamethrin ranged from 14 to 69 days in the corn field while no significant degradation was observed in the cotton field over the 150 day period studied.

Water-sediment systems

Deltamethrin is stable to hydrolytic degradation at low pH, but degrades with a half-life of 2.5 days at pH 9. Two degradation products were identified, *m*PB aldehyde and traces of Br_2CA, presumably formed from deltamethrin on hydrolysis of the ester. Abiotic hydrolysis is unlikely to contribute significantly to the degradation of deltamethrin residues in aquatic systems unless the pH is high.

During irradiation with artificial light (comparable to that of the average New Jersey, USA sunlight) deltamethrin underwent ester hydrolysis and *cis-trans* isomerization. The major photodegradation products identified were *m*PB acid and *cis*-Br_2CA.

When a deltamethrin solution was inoculated with activated sewage sludge it was not readily biodegraded with 74-84% of the initial concentration remaining after 28 days.

In an anaerobic sediment water study, deltamethrin rapidly became associated with the sediment and was quite persistent (50% decline in 6 months). Significant mineralization occurred (28% in 12 weeks). The major compounds found after 12 weeks of incubation were deltamethrin and its α-*R*-deltamethrin (28 to 53%). The half-life of deltamethrin ranged from 2 to 8 weeks, depending upon the water/sediment system. The degradation pathways of deltamethrin in water/sediment systems involved ester hydrolysis and isomerization.

In summary, chemical hydrolysis is only expected to occur in waters having high pH values. Indirect photochemical transformation of deltamethrin may occur but is considered to be only a minor route of degradation. Biodegradation in the aquatic environments is expected to be rather slow. Deltamethrin will mainly be distributed to suspended organic material, biota and eventually to sediments.

Analytical methods

Several different analytical methods have been reported for the analysis of deltamethrin (and isomers) in plant material and animal commodities. The basic approach involves extraction by homogenization with an organic solvent mixture incorporating varying proportions of polar and non-polar solvents depending upon the nature of the matrix being extracted and its water content. In general, a primary liquid – liquid partition follows extraction to transfer deltamethrin residues to less polar solvents prior to column clean-up. In all cases, residues are finally determined by gas chromatography with an electron capture detector. In a small number of the methods deltamethrin and its isomers were resolved, however, the majority of the methods (including those utilised in most of the residue trials and the method proposed as a regulatory method) determine "total deltamethrins" (sum of deltamethrin, α-*R*- and *trans*–deltamethrin).

The methods for deltamethrin have been extensively validated with numerous recoveries on a wide range of substrates with LOQs typically in the range 0.01 to 0.05 mg/kg.

Stability of pesticide residues in stored analytical samples

Freezer storage stability was tested for a range of representative substrates. Residues of deltamethrin (and *trans*- and α-*R*-deltamethrin, when measured) were generally stable for the intervals tested:

- hops and beer (5.5 months)
- lettuce (16 months)
- cotton seed products (13 – 38 months**)**
- grain (9 months**)**
- soybean seed (9 months**)**
- cabbage (24 months)
- tomato (24 months)
- poultry tissues and eggs (11 – 13 months)

No significant isomerization (configurational or epimerisation) occurred during frozen storage.

Residue definition

The residue following its use on crops is predominantly deltamethrin and its isomers (α-*R*- and *trans*–deltamethrin). The isomers, when resolved, individually accounted for up to 38 and 20% of the total deltamethrin residue for the α-*R*- and *trans*–deltamethrin respectively. GLC methods are available that can measure the isomers separately, although most of the methods used in the residue trials measured "total deltamethrins" (sum of deltamethrin, α-*R*- and *trans*–deltamethrin).

Based on the actual residue measured, the Meeting recommended that the residue definition for plant and animal commodities for compliance with MRLs and for estimation of dietary intake should be sum of deltamethrin, α-*R*- and *trans*–deltamethrin.

The log K_{ow} of 4.6 (pH 7) and the animal metabolism and feeding studies suggest that deltamethrin should be described as fat-soluble.

The Meeting recommended that deltamethrin be described as fat-soluble

Proposed definition of the residue (for compliance with MRL and for estimation of dietary intake): sum of deltamethrin, α-*R*- and trans–deltamethrin ([1*R*-[1α(*R**),3α]]-α-cyano-3-phenoxybenzyl 3-(2,2-dibromovinyl)-2,2-dimethylcyclopropanecarboxylate and [1*R*-[1α(*S**),3β]]-α-cyano-3-phenoxybenzyl 3-(2,2-dibromovinyl)-2,2-dimethylcyclopropanecarboxylate.

The residue is fat-soluble.

Results of supervised trials

Supervised trials were available for the use of deltamethrin on numerous crops: artichokes, apples, black currants, beetroot, Brassica vegetables (broccoli, Brussels sprouts, cauliflower), cacao, carrots, cereal grains, cherries, chicory, coffee, cotton, cucurbits (cucumber, melon, zucchini), egg plant, fodder peas, grapes, hazel nuts, leafy vegetables (kale, lettuce, spinach), leeks, legume vegetables (beans, peas), lupins, mandarins, maize, mushrooms, nectarines, olives, onions, oranges, parsnip, pasture (alfalfa, grass), peaches, peppers, plums, potatoes, pulses, radish, raspberries, rape, sorghum, soybeans, stone fruit, strawberries, sugar beet, sunflower, sweet corn, sweet potato, tea, tomatoes and walnuts.

No relevant GAP was available to evaluate data for black currants, raspberries, lupins, beetroot, sugar beet, parsnip, chicory, sweet potato, artichokes, coffee, cacao and pasture. Only those trials with relevant GAP are discussed in the following sections.

Trial data or relevant GAP were not submitted for several crops with current recommendations for maximum residue levels: artichoke, globe (0.05 mg/kg), banana (0.05 mg/kg), cacao beans (0.05 mg/kg), coffee beans (2 mg/kg P_O), fig (0.01* mg/kg), hops dry (5 mg/kg), kiwifruit (0.05 mg/kg), peanut (0.01* mg/kg), pineapple (0.01* mg/kg) and tree tomato (0.02 mg/kg). The Meeting agreed to withdraw its previous maximum residue level recommendations for these commodities.

Citrus. Deltamethrin is registered in the Italy for use on citrus fruits at 0.75-1.7 g ai/hl with a PHI of 20 days. None of the Italian trials matched GAP for that country. In Spain deltamethrin is registered for use on citrus at 0.75-1.3 g ai/hl with a PHI of 35 days. Trials conducted at ±30% of the maximum spray concentration and harvested at 29-32 days were considered to match GAP for Spain by the Meeting. In addition the Italy trials were evaluated against the Spain GAP. The residues resulting from Italy and Spain trials in 2001 meeting those conditions were: mandarin <0.01 (4) mg/kg; oranges <0.01 (3) and 0.01 (2) mg/kg. Residues from the two fruits appear to be from the same population and

may be evaluated together. Deltamethrin residues in citrus from 9 trials matching GAP in Spain in rank order (median underlined) were: <u><0.01</u> (7) and 0.01 (2) mg/kg.

The Meeting estimated a maximum residue level, an STMR value and an HR value for deltamethrin in citrus whole fruit of 0.02, 0.01 and 0.01 mg/kg, respectively. The Meeting agreed to withdraw its previous recommendation of 0.05 mg/kg for mandarins and oranges, sweet, sour.

<u>Apples</u>. Data were available from supervised trials on apples in France (GAP: 0.75-1.8 g ai/hl, PHI 7 days), Germany (no GAP), Greece (GAP: 0.88-2.3 g ai/hl; PHI 15 days), Italy (GAP: 0.75-2.5 g ai/hl, PHI 3 days) and Spain (GAP: 0.75-1.3 g ai/hl, PHI 7 days), however with the exception of Spain, the trials did not match GAP of the country they were conducted in. The Meeting decided to evaluate the trials from France and Germany according to the GAP of Belgium and those from Greece and Italy according to the GAP of Portugal.

In Belgium, deltamethrin is registered for application to apples at rates of 3-12 g ai/ha with a spray concentration range of 0.7-1 g ai/hl and a PHI of 7 days. Residues of deltamethrin from seven trials in France at 13 g ai/ha with a PHI of 7 days were 0.02 (4), 0.03 (2) and 0.04 mg/kg. In eighteen trials from Germany at 11 g ai/ha with PHIs of 7 days the residues of deltamethrin were 0.01 (2), 0.02 (3), 0.03 (2), 0.04 (2), 0.05 (4), 0.06 (3), 0.07 and 0.08 mg/kg.

Deltamethrin is registered in Spain for apples (pome fruit) with an application rate 0.75-1.3 g ai/hl and a PHI of 7 days. In six trials that matched GAP for Spain the residues of deltamethrin were of 0.02, 0.03 (2), 0.04 (2) and 0.07 mg/kg.

GAP in Portugal is 0.75 g ai/hl with a 7 day PHI. In three trials from Greece, four from Italy and one from Spain at 0.8 g ai/hl with a PHI of 7 days the residues of deltamethrin were <0.01, 0.02 (3), 0.03 and 0.04 (3) mg/kg, respectively.

The residues from the trials were combined as they appeared to be from the same population. Residues in rank order, median underlined, were: <0.01, 0.01 (2), 0.02 (11), <u>0.03</u> (7), 0.04 (8), 0.05 (4), 0.06 (3), 0.07 (2) and 0.08

The Meeting estimated a maximum residue level, an STMR value and an HR value for deltamethrin in apples of 0.2 mg/kg, 0.03 mg/kg and 0.08 mg/kg, respectively. The Meeting agreed to withdraw its previous recommendation of 0.1 mg/kg for pome fruit.

<u>Stone fruits</u>. Trials on cherries were conducted in France (GAP 1.3 g ai/hl, PHI 7 days) and Germany (no GAP). Two of the France trials matched GAP in that country and had deltamethrin residues of <0.018 and 0.15 mg/kg in whole fruit at seven days after application at 1.3-1.5 g ai/hl.

The Meeting agreed that the two trials were not sufficient for the purposes of estimating a maximum residue level for cherries.

Data were available from supervised trials on peaches and nectarines in France (GAP: 0.75-1.8 g ai/hl, PHI of 7 days), Germany (no GAP), Greece (GAP: 0.88-2.3 g ai/hl, PHI 15 days), Italy (GAP: 0.75-2.2 g ai/hl, PHI 3 days) and Spain (GAP: 0.75-1.3 g ai/hl, PHI 7 days), however, the trials did not match GAP of the country in which they were conducted. The Meeting decided to evaluate the trials from Germany (no GAP) according to the GAP of France and those from Italy according to the GAP of Spain.

Three trials from Germany approximated French GAP with deltamethrin residues of 0.02, 0.03 and 0.03 mg/kg at 7 days after application at 1.3 g ai/hl. A single trial from Italy matched Spain GAP and had a residue of <0.05 mg/kg.

Trials on plums were available from France (GAP 0.75-1.8 g ai/hl, PHI 7 days) and Germany (no GAP). Two of the France trials matched GAP in that country and had deltamethrin residues of 0.005 and 0.009 mg/kg in whole fruit at seven days after application at 1.3 g ai/hl, i.e. within 30% of the France GAP spray concentration. The Meeting decided to evaluate the trials from Germany according to the GAP of France. Two trials from Germany matched the GAP of France with residues of <0.01 and 0.02 mg/kg, the latter being the higher of the residues measured at 7 and 14 days after the last spray.

The Meeting considered that the residues of deltamethrin on peaches, nectarines and plums were similar and that the residues from the trials in the different crops could be used in mutual support of each other. The residues of deltamethrin in peaches, nectarines and plums from trials according to GAP were: 0.005, 0.009, <0.01, 0.02 (2), 0.03 (2) and <0.05 mg/kg.

The Meeting estimated maximum residue levels, STMRs and HRs for peaches, nectarines and plums of 0.05, 0.02 and 0.05 mg/kg, respectively. The Meeting agreed to withdraw its previous recommendation of 0.05 mg/kg for stone fruit and to recommend maximum residue levels of 0.05 mg/kg for peaches, nectarines and plums.

Strawberries. Trials on strawberries from France, Germany (no GAP), Italy, Spain and the UK (no GAP) were made available to the Meeting. The Meeting decided to evaluate the trials from Germany (no GAP) and the UK (no GAP) according to the GAP of France.

In France deltamethrin is registered for use on strawberries at 13 g ai/ha with a PHI of 3 days. In eleven trials from France matching GAP, four under plastic tunnels and one glasshouse, residues of deltamethrin were <0.02 (3), 0.02 (3), 0.03 (3), 0.04 and 0.05 mg/kg. In nine trials from Germany matching the GAP of France, residues of deltamethrin were <0.02 (9) mg/kg. Three trials from the UK matched GAP of France with residues of 0.02, 0.03 and 0.03 mg/kg.

Deltamethrin is registered in Italy for use on strawberries at 0.75-1.3 g ai/hl with a PHI of 3 days. A single trial from Italy matched GAP with residue of <0.01 mg/kg. None of the Spain trials matched GAP of that country, however, the Meeting decided that the Spain trials could be evaluated according to the GAP of Italy. Three Spain trials matched GAP of Italy with residues of 0.03, 0.06 and 0.10 mg/kg.

The residues on strawberries listed above were all from trials carried out at 13 g ai/ha with a 3 day PHI. The Meeting decided that the trials could be considered as a single population for the purposes of estimating a maximum residue level. Residues in rank order, median underlined, were: <0.01, ≤0.02 (12), 0.02 (4), 0.03 (6), 0.04, 0.05, 0.06 and 0.10 mg/kg.

The Meeting estimated a maximum residue level, an STMR value and an HR value for deltamethrin in strawberries of 0.2 mg/kg, 0.02 mg/kg and 0.1 mg/kg, respectively. The recommendation of a maximum residue level of 0.2 mg/kg replaces the previous recommendation of 0.05 mg/kg for strawberries.

Grapes. Trials on grapes from France (GAP: 7.5-18 g ai/ha, PHI 7 days), Germany (no GAP), Italy (GAP: 0.75-1.7 g ai/hl, PHI 3 days) and Spain (GAP: 7.5-13 g ai/ha, PHI 7 days or 0.75-1.3 g ai/hl, PHI 3 days) were made available to the Meeting. The Meeting decided to evaluate the trials from Germany (no GAP) according to the GAP of France.

In France deltamethrin is registered for use on grapes at 7.5-18 g ai/ha with a PHI of 7 days. In six trials from France matching GAP, residues of deltamethrin in grapes harvested at 7 days or more after the last spray were 0.01, 0.02, 0.03, 0.03, 0.05 and 0.06 mg/kg. In a single trial from Germany matching the GAP of France, residues of deltamethrin were 0.02 mg/kg.

Deltamethrin is registered in Spain for use on grapes at 7.5-13 g ai/ha with a PHI of 7 days. A single trial from Spain matched GAP with residue of 0.07 mg/kg. None of the Italy trials matched GAP of that country. However, the Meeting decided that the Italy trials could be evaluated according to the GAP of Spain. Two Italy trials approximated GAP of Spain with residues of 0.06 and 0.09 mg/kg.

The residues on grapes listed above were all from trials carried out at with the last spray at 17-19 g ai/ha and with a 7 day PHI. The Meeting decided that the trials could be considered as a single population for the purposes of estimating a maximum residue level. Residues in rank order, median underlined, were: 0.01, 0.02 (2), 0.03 (2), 0.05, 0.06 (2), 0.07 and 0.09 mg/kg.

The Meeting estimated a maximum residue level, an STMR value and an HR value for deltamethrin in grapes of 0.2 mg/kg, 0.04 mg/kg and 0.09 mg/kg, respectively. The recommendation of a maximum residue level of 0.2 mg/kg replaces the previous recommendation of 0.05 mg/kg for grapes.

Olives. Trials on olives from France (GAP: 1.3-1.8 g ai/hl, PHI 7 days), Greece (GAP: 1-1.8 g ai/hl, PHI 15 days), Italy (GAP: 1-1.5 g ai/hl, PHI 3 days), Portugal (GAP: 1.3 g ai/hl, PHI 7 days) and Spain (GAP: 5 g ai/ha, PHI 7 days) were made available to the Meeting.

In two trials from France approximating GAP, residues of deltamethrin in olives were 0.22 and 0.54 mg/kg.

One trial from Italy matched GAP from that country with a maximum observed residue of 0.12 mg/kg at 3 or more days after the last spray.

One trial from Portugal matched GAP from that country with a deltamethrin residue of 0.15 mg/kg.

One of the Italy and none of the Spain or Greece trials matched GAP of those countries, however, the Meeting decided that these trials could be evaluated according to the GAP of Portugal. A single trial from Greece, one from Italy and one from Spain approximated the GAP of Portugal (within 30% of the spray concentration) with residues of 0.02, 0.14 and 0.18 mg/kg, respectively.

The Meeting decided that the trials from France, Greece, Italy, Portugal and Spain could be combined for the purposes of estimating a maximum residue level. Residues in rank order, median underlined, were: 0.02, 0.12, 0.14, 0.15, 0.18, 0.22 and 0.54 mg/kg.

The Meeting estimated a maximum residue level for deltamethrin in olives of 1 mg/kg to replace the previous recommendation of 0.1 mg/kg.

Information on residues in the edible portion were also available. Residues in olive pulp for the five trials considered in estimating the maximum residue level for whole fruit were 0.04, 0.18, 0.21, 0.25 and 0.31 mg/kg. The Meeting estimated an STMR value and an HR value for deltamethrin in olive pulp of 0.21 mg/kg and 0.31 mg/kg, respectively.

Onions. Trials on onions from France (GAP: 7.5-13 g ai/ha, PHI 7 days), Germany (no GAP), Greece (GAP: 0.88-1.9 g ai/hl, PHI 7 days), Italy (GAP: 0.75-1.5 g ai/hl, PHI 7 days), Spain (GAP: 0.75-1.3 g ai/hl, PHI 7 days) and the UK (no GAP) were made available to the Meeting. As there is no GAP for onions in Germany, the Meeting decided to evaluate these trials according to the GAP of France.

In five trials from France approximating GAP, residues of deltamethrin in onions were <0.02 (5) mg/kg.

Residue in seven trials from Germany approximating GAP in France were ≤0.02 (4), and 0.03 (3) mg/kg.

Residues in rank order for trials approximating the GAP of France, median underlined, were: ≤0.02 (9) and 0.03 (3) mg/kg.

The Meeting estimated a maximum residue level, an STMR value and an HR value for deltamethrin in onions of 0.05 mg/kg, 0.02 mg/kg and 0.03 mg/kg, respectively.

Leeks. Trials on leeks from France (GAP: 7.5-13 g ai/ha, PHI 7 days), Germany (no GAP), Greece (GAP: 0.88-1.9 g ai/hl, PHI 7 days), Italy (GAP: 0.75-1.5 g ai/hl, PHI 7 days), Spain (GAP: 0.75-1.3 g ai/hl, PHI 7 days) and the UK (no GAP) were made available to the Meeting. As there is no GAP for leeks in Germany or the UK, the Meeting decided to evaluate these trials according to the GAP of France.

In two trials from France approximating GAP, residues of deltamethrin in leeks were 0.04 and 0.09 mg/kg.

Residue in three trials from Germany approximating GAP in France were ≤0.02, 0.03 and 0.07 mg/kg. Residue in two trials from the UK approximating GAP in France were 0.08 and 0.13 mg/kg.

Residues leeks in rank order for trials approximating the GAP of France, median underlined, were: <0.02, 0.03, 0.04, 0.07, 0.08, 0.09 and 0.13 mg/kg.

The Meeting estimated a maximum residue level, an STMR value and an HR value for deltamethrin in leeks of 0.2 mg/kg, 0.07 mg/kg and 0.13 mg/kg, respectively.

The recommended maximum residue levels of 0.05 and 0.2 mg/kg for onions and leeks, respectively replace the previous recommendation of 0.1 mg/kg for bulb vegetables, except fennel bulb which is now withdrawn.

Brassica vegetables. Deltamethrin is registered in Australia for use on Brussels sprouts at 11-14 g ai/ha or 1.1-1.4 g ai/hl with a PHI of 2 days. In a single trial in Australia approximating GAP deltamethrin residues were <0.05 mg/kg. The Meeting decided that a single trial is inadequate for the purposes of estimating a maximum residue level.

Trials were available from France (no GAP), Greece (GAP 0.88-1.9 g ai/hl, PHI 7 days), Italy (no GAP) and Spain (GAP: 0.75-1.3 g ai/hl, PHI 7 days) on broccoli and cauliflower. As there is no GAP for broccoli or cauliflower in France and Italy, the Meeting decided to evaluate the trials of France according to the GAP of Belgium and the trials from Italy according to the GAP of Greece.

Residue in two trials from France approximating GAP in Belgium were ≤0.02 (2) mg/kg. Residues in two trials from Greece approximating GAP from that country were <0.02 (2) mg/kg while residues of deltamethrin in three trials from Italy approximating the GAP of Greece were <0.02 (2) and 0.04 mg/kg.

The residue evaluated according to GAP of Belgium and Greece appeared to be from the same population and could be combined for the purposes of estimating a maximum residue level. Residues broccoli and cauliflower in rank order, median underlined, were: <0.02 (6) and 0.04 mg/kg.

The Meeting estimated a maximum residue level, an STMR value and an HR value for deltamethrin in flowerhead brassicas of 0.1 mg/kg, 0.02 mg/kg and 0.04 mg/kg, respectively. The recommendation for a maximum residue level of 0.1 mg/kg for flowerhead brassicas replaces the previous recommendation of 0.2 mg/kg for Brassica vegetables which is withdrawn.

Cucurbit vegetables. Trials on cucumbers were reported from France (GAP: 7.5-13 g ai/ha, PHI 3 days), Denmark (no GAP), Germany (no GAP), Greece (GAP: 0.88-1.9 g ai/hl, PHI 3 cucumber), Italy (GAP: 0.75-1.5 g ai/hl, PHI 3 days cucumber) and Spain (GAP: 0.75-1.3 g ai/hl, PHI 3 days) and UK (GAP: 1.8 g ai/hl, PHI nil) were made available to the Meeting. As there is no GAP for cucumbers in Germany, the Meeting decided to evaluate the Germany field trials according to the GAP of France and the Denmark and Germany glasshouse trials according the GAP of the UK.

Residue in four field trials from Germany approximating GAP in France deltamethrin residues in cucumber were ≤0.01 (4) mg/kg. In a single field trial from Italy approximating GAP from that country residues of deltamethrin in cucumber were <0.02 mg/kg. In three glasshouse trials conducted in the UK matching GAP residues of deltamethrin were 0.02 (2) and 0.09 mg/kg. In four glasshouse trials from Germany approximating the GAP of the UK residues of deltamethrin in cucumber were 0.02 (3) and 0.03 mg/kg.

Residues cucumbers from field trials in rank order, median underlined, were: ≤0.01 (4) and <0.02 mg/kg.

Residues cucumbers from glasshouse trials in rank order, median underlined, were: 0.02 (5), 0.03 and 0.09 mg/kg.

Trials on zucchini were reported from France (GAP: 7.5-13 g ai/ha, PHI 3 days), Greece (GAP: 0.88-1.9 g ai/hl, PHI 7 days), Italy (no GAP) and Spain (GAP: 0.75-1.3 g ai/hl, PHI 3 days) were made available to the Meeting. As there is no GAP for zucchini in Italy, the Meeting decided to evaluate these trials against GAP of Greece.

In two field trials from France approximating GAP for zucchini, residues of deltamethrin were <0.02 (2) mg/kg. The residue in a single trial on zucchini from the Greece approximating GAP from that country was <0.02 mg/kg. In two field trials from Italy approximating the GAP of Greece, residues of deltamethrin in zucchini were <0.02 (2) mg/kg.

Residues zucchini in rank order for field trials approximating GAP, median underlined, were: ≤0.02 (5) mg/kg.

With the exception of a single trial on gherkins at exaggerated rate, 13 field trials approximating at 1-2 times GAP in France, Greece, Italy and Spain, the residues in cucumbers and zucchini were less than the LOQs of 0.01 and 0.02 mg/kg.

Trials on melon were reported from France (no GAP), Greece (GAP: 0.88-1.9 g ai/hl, PHI 7 days), Italy (no GAP) and Spain (GAP: 0.75-1.3 g ai/hl, PHI 3 days) were made available to the Meeting. As there is no GAP for melon in France, the Meeting decided to evaluate these trials against GAP of Belgium (GAP: 7.5-13 g ai/ha, PHI 3 days). As there is no GAP for melon in Italy, the Meeting decided to evaluate these trials against GAP of Greece.

In six field trials from France matching Belgium GAP, residues of deltamethrin in melon were <0.02 (6) mg/kg. In three trials from Greece and one from Italy that approximated GAP in Greece, residues of deltamethrin in melon were <0.02 (4) mg/kg.

The residues on melons listed above were all from trials carried out at with the last spray at 13 g ai/ha and with residues at 3 or more days after the last spray that were less than the LOQ (0.02 mg/kg).

The Meeting agreed to pool the data to support a cucurbit vegetables MRL, rank order (median underlined): <0.01 (4), ≤0.02 (16), 0.02 (5), 0.03 and 0.09 mg/kg.

The Meeting estimated a maximum residue level, an STMR value and an HR value for deltamethrin in fruiting vegetables, cucurbits of 0.2, 0.02 and 0.09 mg/kg, respectively. The recommended maximum residue level confirms the previous recommendation. In addition the Meeting recommends withdrawal of the previous recommendation for melons except water melons of 0.01 (*) mg/kg as this commodity would be covered by the fruiting vegetable, cucurbit group maximum residue level.

Mushrooms. Trials on mushrooms from France (no GAP) and Germany (no GAP) were made available to the Meeting. As there is no GAP for mushrooms in France, the Meeting decided to evaluate these trials against GAP of Poland (GAP: 0.75 g ai/hl, PHI 2 days).

In four trials, two from France and two from Germany, matching the GAP of Poland, residues of deltamethrin were <0.02 (3) and 0.03.

The Meeting estimated a maximum residue level, an STMR value and an HR value for deltamethrin in mushrooms of 0.05, 0.02 and 0.03 mg/kg, respectively, the maximum residue level replaces the previous recommendation of 0.01 (*) for mushrooms.

Tomatoes. Trials on tomatoes were reported from Australia (GAP: 8.3-14 g ai/ha or 0.83-1.4 g ai/hl, PHI 3 days), Denmark (no GAP), Finland (no GAP), France (GAP: 5-13 g ai/ha, PHI 3 days), Germany (no GAP), Greece (GAP: 0.88-1.9 g ai/hl, PHI 3 days), Italy (GAP: 0.75-1.5 g ai/hl, PHI 3 days), Mexico (GAP: 13 g ai/ha, PHI 1 day), The Netherlands (GAP: 1.3 g ai/hl, PHI 3 days), New Zealand (GAP: 3-9.9 g ai/ha or 0.74-0.99 g ai/hl, PHI 3 days), South Africa (GAP: no GAP), Spain (GAP: 0.75-1.3 g ai/hl, PHI 3 days) and the UK (GAP: 1.8 g ai/hl, PHI nil) were made available to the Meeting. As there is no GAP for tomatoes in Germany, the Meeting decided to evaluate the Germany field trials according to the GAP of France and the Germany glasshouse trials according the GAP of The Netherlands.

The trials from Australia, New Zealand and Mexico were reported in summary form and not evaluated further.

Deltamethrin is registered in France for use on tomatoes at 5-13 g ai/ha with harvest permitted 3 days after the final application. Deltamethrin residues in 5 trials from France matching GAP in rank order were: 0.009, 0.01, 0.016, <0.02 and 0.02 mg/kg and in six from Germany were: <0.01, 0.01, 0.02, 0.03, 0.07, 0.2 mg/kg.

In Greece deltamethrin is registered for use on tomatoes at 0.88-1.9 g ai/hl with harvest permitted 3 days after the final application. In two trials in Greece matching GAP conditions deltamethrin residues were: <0.02 (2) mg/kg. In a further two trials from Italy that approximated GAP in Greece residues were <0.02 (2) mg/kg.

GAP in Italy for deltamethrin use on tomatoes requires a 3 day PHI after application at 0.75-1.5 g ai/hl. Deltamethrin residues in a single tomato trial matching Italy GAP were <0.02 mg/kg.

Residues of deltamethrin in tomatoes from a single trial in Spain that matched GAP from that country were <0.03 mg/kg.

The country or region in which the trials were conducted was considered by the Meeting to be unimportant when considering trials for protected crops (glasshouse). The Meeting decided to evaluate the protected crop trials for tomatoes against the GAP of France as this afforded the largest number of valid residue values for the estimation of a maximum residue level. In eight protected crop trials from Greece, Italy, The Netherlands and Spain, the residues of deltamethrin in tomatoes were <0.01, <0.01, 0.01, 0.01, 0.01, 0.013, 0.014 and 0.03 mg/kg. In a further six trials from Denmark and Germany that approximated the GAP of The Netherlands residues of deltamethrin in tomatoes were 0.03, 0.03, 0.08, 0.1, 0.2 and 0.2 mg/kg.

The Meeting noted that the residues on tomatoes from both the field (0.009, <0.01, 0.01 (2), 0.016, <0.02 (6), 0.02 (2), <0.03, 0.03, 0.07, 0.2 mg/kg) and protected crop (<0.01 (2), 0.01 (3), 0.013, 0.014, 0.03 (3), 0.08, 0.1, 0.2(2) mg/kg) trials appeared to be from the same population and decided that the trials could pooled for the purposes of estimating a maximum residue level. Residues in rank order, median underlined (n=31), were: 0.009, <0.01 (3), 0.01 (5), 0.013, 0.014, 0.016, <u>≤0.02</u> (6), 0.02 (2), <0.03, 0.03 (4), 0.07, 0.08, 0.1 and 0.2 (3) mg/kg.

The Meeting estimated a maximum residue level, an STMR value and an HR value for deltamethrin in tomatoes of 0.3 mg/kg, 0.02 mg/kg and 0.2 mg/kg, respectively.

<u>Peppers</u>. In Canada deltamethrin is registered for use on peppers at 13-15 g ai/ha (5-7.5 g ai/hl) with harvest permitted 3 days after the final application. In four trials in Canada matching GAP conditions deltamethrin residues on peppers were: 0.002 (3) and 0.007 mg/kg.

The residues in 2 indoor trials from the UK approximating GAP in that country (1.8 g ai/hl, PHI nil) were: 0.07 and 0.09 mg/kg.

The Meeting agreed to not to combine the peppers data from Canada and the UK as the data appeared to be from two different populations and considered that there were insufficient data on which to estimate a maximum residue level for peppers.

<u>Sweet corn</u>. Field trials on sweet corn were made available to the Meeting from Canada (GAP: 13-15 g ai/ha, PHI 5 days), France (GAP: 20 g ai/ha, PHI 7 days), Germany (no GAP), Italy (no GAP), New Zealand (GAP: 9.9-12 g ai/ha, PHI 7 days), Portugal (no GAP), Spain (no GAP) and the UK (no GAP). None of the trials matched GAP of the particular country they were conducted in. The Meeting decided to evaluate the trials conducted in Germany and France against the GAP of Belgium. In 10 trials in Germany and France matching GAP conditions for Belgium deltamethrin residues on sweet corn (on the cob) were, median underlined <0.003 (4) and <u>≤0.02</u> (6) mg/kg.

The Meeting estimated a maximum residue level, an STMR value and an HR value for deltamethrin in sweet corn (corn-on-the-cob) of 0.02*, 0.02 and 0.02 mg/kg, respectively.

<u>Eggplants.</u> In France deltamethrin is registered for use on eggplants at 7.5-13 g ai/ha with harvest permitted 3 days after the final application. In a single trial in France matching GAP conditions deltamethrin residues on eggplants were: <0.01 mg/kg.

The Meeting agreed that one trial was not sufficient to recommend a maximum residue level.

The maximum residue level recommendations for tomatoes and sweet corn replace the previous recommendation of 0.2 mg/kg for fruiting vegetables other than cucurbits (except mushrooms).

<u>Leafy vegetables</u>. Field trials on curly kale were made available to the Meeting from Germany (no GAP) and the UK (no GAP). The Meeting decided to evaluate these trials conducted in Germany and the UK against the GAP of The Netherlands (2.5-10 g ai/ha, 1.3 g ai/hl, PHI 7 days). In seven trials in Germany and one in the UK matching GAP conditions for The Netherlands deltamethrin residues on curly kale were, median underlined 0.07, 0.08, 0.1, <u>0.11</u>, <u>0.32</u>, 0.32, 0.34 and 0.39 mg/kg.

In France deltamethrin is registered for use on lettuce at 13 g ai/ha with a 3 day PHI. In trials in France matching GAP, deltamethrin residues in lettuce were: 0.13, 0.18, 0.18, 0.26, 0.29 and 0.41 mg/kg. If the trials conducted in Spain are assessed against GAP of France a further 4 trials matched GAP and had residues of 0.07, 0.12, 0.15 and 0.25 mg/kg. Residues of deltamethrin in lettuce from trials according to GAP were (median underlined): 0.07, 0.12, 0.13, 0.15, <u>0.18</u> (2), 0.25, 0.26, 0.29 and 0.41 mg/kg.

In Belgium deltamethrin is registered for use on spinach at 7.5-13 g ai/ha (1.2-3.1 g ai/hl) with a 7 day PHI. In trials in France (2) and Germany (14) matching GAP conditions for Belgium deltamethrin residues in spinach were: 0.03 (2), 0.04, 0.06, 0.08, 0.09 (2), 0.1 (4), 0.14, 0.17, 0.2, 0.5, 1.0 mg/kg.

The range of residues was quite wide but there was overlap of residue levels with the various crops. The Meeting decided to pool the data to support a leafy vegetable MRL, rank order (median underlined, n=34): 0.03 (2), 0.04, 0.06, 0.07 (2), 0.08 (2), 0.09 (2), 0.1 (5), 0.11, 0.12, 0.13, 0.14, 0.15, 0.17, 0.18 (2), 0.2, 0.25, 0.26, 0.29, 0.32 (2), 0.34, 0.39, 0.41, 0.5, 1.0 mg/kg.

The Meeting estimated a maximum residue level, an STMR value and an HR value for deltamethrin in leafy vegetables of 2, 0.125 mg/kg and 1 mg/kg, respectively. The recommendation of 2 mg/kg for leafy vegetables replaces the previous recommendation of 0.5 mg/kg.

Legume vegetables. Field trials on succulent beans were made available to the Meeting from France (GAP: 13 g ai/ha, PHI 7 days), Germany (no GAP), Greece (GAP: 0.88-1.9 g ai/hl, PHI 3 days), Italy (GAP: 0.75-1.3 g ai/hl, PHI 3 days), Portugal (GAP; 1.3 g ai/hl, PHI 2 days) and Spain (GAP: 0.75-1.3 g a/hl, PHI 3 days). The Meeting decided to evaluate the German trials against the GAP of France.

In eight trials conducted in France and approximating GAP in that country the residues of deltamethrin in beans with pods were: <0.005, <0.005, 0.02, 0.03, 0.05 (3) and 0.14 mg/kg.

Eight German trials matched the GAP of France with residues of deltamethrin of <0.01 (6) and 0.01 (2) mg/kg.

Field trials on succulent peas were made available to the Meeting from France (GAP: 13 g ai/ha, PHI 3 days), Germany (no GAP) and the UK (GAP: 6.3-7.5 g ai/ha, PHI 7 days).

Residues of deltamethrin in peas with pods were: <0.01 (2), 0.06 and 0.1 mg/kg for trials conducted in France and Germany and evaluated against the GAP of France.

Field trials on succulent beans, shelled were made available to the Meeting from France (GAP: 13 g ai/ha, PHI 7 days) and Germany (no GAP). None of the trials from France matched GAP. The Meeting decided to evaluate the German trials against the GAP of France. In 4 trials from Germany that approximated the GAP of France the residues of deltamethrin in shelled beans were: <0.01 (3) and 0.01 mg/kg. Field trials on succulent peas, shelled were made available to the Meeting from France (GAP: 13 g ai/ha, PHI 7 days), Germany (no GAP) and the UK (6.3-7.5 g ai/ha, PHI nil). The Meeting decided to evaluate the German and UK trials against the GAP of France. In two trials from France, one from the UK and four from Germany that approximated the GAP of France the residues of deltamethrin in shelled peas were: <0.01 (3) and <0.015 (4) mg/kg.

The residues of deltamethrin in shelled beans and peas are much lower than for the whole pods as expected for a compound that is not readily translocated and the Meeting considered that the residues values from shelled beans and peas (seed) should not be combined with data from whole pods for the purposes of estimating a maximum residue level.

The Meeting agreed to pool the data from beans with pods and peas with pods and estimate a maximum residue level for legume vegetables. Residues, in rank order (median underlined) were: <0.005, <0.005, <0.01 (8), 0.01 (2), 0.02, 0.03, 0.05 (3), 0.06, 0.1 and 0.14 mg/kg.

The Meeting estimated a maximum residue level, an STMR value and an HR value for deltamethrin in legume vegetables of 0.2, 0.01 and 0.14 mg/kg, respectively. The estimated maximum residue level replaces the previous recommendation of 0.1 mg/kg for legume vegetables.

Pulses

Soy beans. Field trials on soy beans were made available to the Meeting from Australia (GAP: 14 g ai/ha, PHI 7 days), France (no GAP), Ivory Coast (no GAP) and Mexico (GAP: 10-13 g ai/ha, PHI 1 day). However, the trials were supplied in the form of summary reports and insufficient detail was presented to allow evaluation of the trials.

Deltamethrin is registered for use on stored grain legumes in Spain with application at 0.5-1 g ai/tonne. The Meeting considered that the location of the trials on stored grain legumes were not relevant in assessing whether or not a trial was conducted according to GAP and that for the purposes of evaluating the data on stored grain legumes a GAP of 1 g ai/tonne would be used.

In two trials from Brazil on stored beans approximating GAP, residues of deltamethrin were 0.2 and 0.26 mg/kg. In four trials from France approximating GAP and involving haricot beans (2), peas and lentils, the residues in the treated grain were 0.45, 0.6, 0.7 and 0.85 mg/kg.

The Meeting agreed that the results for the individual pulses could be combined for the purpose of estimating a maximum residue level. The residue levels for deltamethrin in stored pulses in rank order, median underlined (n=6), were: 0.2, 0.26, 0.45, 0.6, 0.7 and 0.85 mg/kg.

The Meeting estimated a maximum residue level, an STMR value and an HR value for deltamethrin in pulses of 1, 0.5 and 0.85 mg/kg, respectively. The maximum residue level for pulses of 1 mg/kg replaces the previous individual recommendations of 1 mg/kg for beans (dry), field pea (dry) and lentil (dry) which the Meeting agreed to withdraw.

Carrots. Field trials on carrots were made available to the Meeting from France (no GAP), Germany (no GAP), Greece (GAP: 1.5 g ai/hl, PHI 7 days), Italy (GAP: 0.75-1.5 g ai/hl, PHI 3 days), Portugal (no GAP) and the UK (no GAP). None of the trials matched GAP of the particular country they were conducted in. The Meeting decided to evaluate the trials conducted in France, Germany and the UK against the GAP of Belgium (7.5-13 g ai/ha or 1.2-3.1 g ai/hl, PHI 7 days). In 7 trials in Germany, 2 in France and one from the UK matching GAP conditions for Belgium, deltamethrin residues on carrots were, median underlined ≤0.01 (6), <0.02 (3) and 0.02 mg/kg.

The Meeting estimated a maximum residue level, an STMR value and an HR value for deltamethrin in carrots of 0.02, 0.01 and 0.02 mg/kg, respectively.

Potatoes. Field trials on potatoes were made available to the Meeting from France (GAP: 13 g ai/ha, PHI 3 days), Germany (no GAP), Greece (GAP: 0.88-1.5 g ai/hl, PHI 15 days), Portugal (GAP: 0.75 g ai/hl, PHI 7 days) and Spain (GAP: 0.75-1.3 g ai/hl, PHI 3 days). None of the trials matched GAP of the particular country they were conducted in. The Meeting decided to evaluate the trials conducted in Germany against the GAP of Belgium (7.5 g ai/ha or 2.5 g ai/hl, PHI 7 days). In 4 trials in Germany matching GAP conditions for Belgium deltamethrin residues on potatoes were <0.01 (4) mg/kg.

The Meeting noted that residues in six trials from Greece, Portugal and Spain conducted at two times the Belgium GAP rate were all <0.02 mg/kg and decided that the trials conducted at the higher rate could be used to support the GAP trials for the purposes of estimating a maximum residue level for potatoes. The Meeting estimated a maximum residue level, an STMR value and an HR value for deltamethrin in potatoes of 0.01*, 0.01 and 0.01 mg/kg, respectively.

Radish. France GAP permits application of deltamethrin to radish at 5 g ai/ha with harvest 7 days after the final application. The single trial on radish from France did not match GAP from that country. Deltamethrin is not registered for use in Germany. The Meeting decided to evaluate the residue trials from Germany against the GAP of Belgium which is application at 5-13 g ai/ha or at a spray concentration of 1.2-3.1 g ai/hl with harvest 7 days after the last spray. In 8 trials from Germany

where conditions approximated GAP in Belgium deltamethrin residues in radish roots were ≤0.005 (4) and ≤0.01 (4) mg/kg.

The Meeting estimated a maximum residue level, an STMR value and an HR value for deltamethrin in radish of 0.01*, 0.01 and 0.01 mg/kg, respectively.

Tree nuts. Deltamethrin is registered in France for use on walnuts with application at 0.75-1.3 g ai/hl and a 14 day PHI. In two trials in France that approximated GAP the deltamethrin residues in nutmeat were all <LOQ (0.02 mg/kg). In other trials with application at spray concentrations of 0.83-1.4 g ai/hl where walnuts were harvested at 0 and 29-30 days later residues were all <0.02 mg/kg.

Trials were available from France (0.75 g ai/hl, PHI 14 days), Italy (no GAP) and Spain (no GAP) on hazelnuts. The Meeting agreed to evaluate all the trials according to the GAP of France. Residues of deltamethrin in nutmeat from five trials conducted at exaggerated rates (1.3-2.5 g ai/hl) were <0.02 mg/kg at 0 and 28-31 days after three applications.

The Meeting agreed that the trials on walnuts and hazelnuts conducted according to GAP and at higher rates could be combined in support of each other to estimate maximum residue levels for hazelnuts and walnuts. The Meeting estimated a maximum residue level, an STMR value and an HR value for deltamethrin in hazelnuts and pulses of 0.02*, 0.02 and 0.02 mg/kg, respectively.

Cereals. Field trials on wheat were made available to the Meeting from France (GAP: 6.3-7.5 g ai/ha, PHI 30 days), Germany (no GAP) and the UK (5-6.3 g ai/ha; last application before grain watery ripe GS 71). In a single trial from France that matched GAP, residues of deltamethrin in wheat grain were <0.02 mg/kg. None of the trials for Germany and the UK matched GAP of the particular country they were conducted in. The Meeting decided to evaluate the trials conducted in Germany and the UK against the GAP of France. In two trials in Germany and one in the UK that matched the GAP conditions for France deltamethrin residues in wheat grain were <0.02 (3) mg/kg.

The Meeting decided that four trials are insufficient for the purposes of estimating a maximum residue level for wheat.

Deltamethrin is registered in several countries for use on stored grain, including cereals, at rates ranging from 0.065 g ai/tonne to 1 g ai/tonne. The Meeting considered that the location of the trials on stored grain were not relevant in assessing whether or not a trial was conducted according to GAP and that for the purposes of evaluating the data on stored grains a GAP of 1 g ai/tonne would be used.

Four trials on stored maize approximated GAP, two in France and three in Italy. Residues of deltamethrin in stored maize were 0.34, 0.5, 0.58, 0.7 and 0.74 mg/kg.

Residues of deltamethrin in 3 trials from Belgium and 1 from Brazil on wheat from stored bulk grain in rank order were: 0.21, 0.7, 1.0 and 1.1 mg/kg.

In a single trial on barley from France that matched GAP for stored cereal grain the deltamethrin residue was 0.9 mg/kg.

In three trials on stored sorghum from France, the residues of deltamethrin were 0.45, 0.7 and 0.7 mg/kg.

Residues of deltamethrin in stored rice grain from trials from Brazil were 0.37, 0.55 and 0.80 mg/kg.

The Meeting agreed that the results for the individual cereal grains could be combined for the purpose of estimating a maximum residue level. The residue levels for deltamethrin in stored cereal

grains in rank order, median underlined (n=16), were: 0.21, 0.34, 0.37, 0.45, 0.5, 0.55, 0.58, 0.7 (4), 0.74, 0.80, 0.9, 1.0 and 1.1 mg/kg.

The Meeting estimated a maximum residue level, an STMR value and an HR value for deltamethrin in cereal grain of 2, 0.7 and 1.1 mg/kg, respectively. The estimated maximum residue level of 2 mg/kg replaces the previous recommendation of 1 mg/kg for cereal grains.

Cotton seed. In India deltamethrin is registered for use on cotton at 10-13 g ai/ha with harvest permitted 30 days after the final application. None of the India trials matched GAP for India.

Deltamethrin is registered in Mexico for use on cotton with application at 13 g ai/ha and a 1 day PHI. In one trial in Mexico, with 0 days PHI deltamethrin residues in cotton seed were <LOQ (0.01 mg/kg).

Deltamethrin is registered in the USA for use on cotton at 15-34 g ai/ha with harvest permitted 21 days after the final application. No USA trials matched the GAP of the USA.

The Meeting decided that as cotton seed is a major commodity, a single trial from Mexico according to GAP is not sufficient for the purposes of recommending a maximum residue level.

Sunflower seed. Field trials on sunflowers were made available to the Meeting from Canada (GAP: 5 g ai/ha, PHI 70 days), France (GAP: 7.5 g ai/ha, PHI 60 days), Greece (no GAP), Germany (no GAP), Italy (no GAP) and Spain (GAP: 13-18 g ai/ha or 0.75-1.3 g ai/hl, PHI 35 days).

The trials from Canada were supplied as summaries and could not be evaluated. In two trials from France approximating GAP residues of deltamethrin in sunflower seeds were <0.01 and <0.05 mg/kg. The Meeting decided to evaluate the Greece, Germany, Italy and Spain trials against the GAP of France, residues in 2 trials from Germany matching GAP of France were <0.01 (2) mg/kg, and one each from Greece, Italy and Spain were <0.05 (3) mg/kg.

The Meeting estimated a maximum residue level, an STMR value and an HR value for deltamethrin in sunflower seed of 0.05*, 0.05 and 0.05 mg/kg, respectively.

The Meeting agreed that the previous recommendations for oilseeds and oilseeds except peanuts of 0.1 mg/kg be withdrawn.

Tea. In India deltamethrin is registered for use on tea at 2.5-10 g ai/ha with harvest permitted 3 days after the final application. In six trials in India matching GAP conditions deltamethrin residues in black tea were: 0.77, 2.2, 2.2, 2.3, 2.3 and 3.1 mg/kg.

Deltamethrin residues in green leaf tea from Taiwan in trials approximating GAP for that country (8.8 g ai/ha, PHI 10 days) were 0.75 and 1.5 mg/kg.

The Meeting agreed that the two sets of residue data could be combined for the purposes of estimating a maximum residue level. The residues of deltamethrin in tea in rank order, median underlined were: 0.75, 0.77, 1.5, 2.2, 2.2, 2.3, 2.3 and 3.1 mg/kg.

The Meeting estimated a maximum residue level, an STMR value and an HR value for deltamethrin in Tea, green, black (black, fermented and dried) of 5, 2.2 and 3.1 mg/kg respectively. The maximum residue level recommendation of 5 mg/kg replaces the previous recommendation of 10 mg/kg for tea, green, black.

Rape forage. Field trials on rape were made available to the Meeting from France (GAP: 6.3 g ai/ha, PHI 28 days for rape) and Germany (no GAP). None of the trials matched GAP of the particular country they were conducted in. The Meeting decided to evaluate the trials conducted in France and

Germany against the GAP of The Netherlands (7.5 g ai/ha, PHI nil days). In 2 trials in France and 17 from Germany matching GAP conditions for The Netherlands residues on rape forage (plants or shoots) were 0.02, 0.037, 0.04, 0.07, 0.09 (2), 0.1 (3), 0.14, 0.16, 0.17, 0.19, 0.24 (2), 0.25 (2), 0.3 and 0.56 mg/kg.

The Meeting estimated an STMR and a high residue value for deltamethrin in rape forage of 0.14 and 0.56 mg/kg, respectively, both on a fresh weight basis.

Alfalfa. Field trials on alfalfa were made available to the Meeting from France (GAP: 6.3 g ai/ha, PHI 21 days) and New Zealand (GAP: 6.2 g ai/ha, PHI 21 days). None of the trials matched GAP of the particular country they were conducted in. The Meeting decided to evaluate the trials conducted in the south of France and against the GAP of Italy (15 g ai/ha, PHI 15 days). In 4 trials in France approximating GAP conditions for Italy residues on alfalfa forage were 0.07, 0.1, 0.11 and 0.16 mg/kg.

The Meeting considered the number of trials was insufficient to permit a maximum residue level to be estimated for deltamethrin on an important crop such as alfalfa forage and agreed to withdraw its previous recommendation of 0.5 mg/kg (dry) for legume animal feeds.

Wheat straw and fodder. In two trials in Germany and one in the UK that matched the GAP conditions for France deltamethrin residues in residues in wheat straw were 0.09, 0.12, 0.39 and 0.41 mg/kg. The Meeting decided that four trials was not sufficient to estimate a maximum residue level for straw and fodder (dry) of cereal grain and agreed to withdraw its current recommendation of 0.5 mg/kg.

Processing

The meeting received information on the fate of incurred residues of deltamethrin residues during the processing of apples, plums, tomatoes, olives, rice, maize, wheat, sorghum and rape seed (canola). The field incurred residues of deltamethrin in the rape seed used for processing were too low to allow meaningful processing factors to be derived for rape seed. Processing factors were calculated for processed commodities derived from these raw agricultural commodities using total deltamethrin residues. When residues in the processed commodity did not exceed the LOQ the processing factor was calculated from the LOQ and was prefixed with a 'less than' symbol (<).

The deltamethrin processing factor for apples to wet pomace and to juice were 5.7 and <0.09, respectively. These factors applied to the STMR (0.03 mg/kg) and MRL (0.2 mg/kg) for apples provide the STMR-P and highest residue for wet apple pomace (0.17 and 1.1 mg/kg) and applied to the apple STMR provide the STMR-P value for apple juice (0.0027 mg/kg).

The mean processing factors (“total deltamethrins”) for olives to crude oil and refined oil were 1.5 and 1.6, respectively. These factors applied to the STMR for olives (0.21 mg/kg) provided the STMR-Ps for crude oil (0.315 mg/kg) and refined oil (0.336 mg/kg).

The processing factors for tomatoes to purée and paste were both <0.1. These factors applied to the STMR (<0.02 mg/kg) for tomatoes provided the STMR-Ps for tomato purée and tomato paste of 0.002 mg/kg.

The processing factors for rice grain to hulls (4.5), mill by-products (0.21), brown rice (0.15), bran (1.5) and polished rice (<0.06) when applied to the STMR for cereal grain (0.7 mg/kg), provide STMR-Ps for hulls (3.15 mg/kg), mill by-products (0.147 mg/kg), brown rice (0.105 mg/kg), bran (1.05 mg/kg) and polished rice (0.042 mg/kg).

The processing factors for dry milling of maize to germ and oil were higher than for wet milling. The Meeting decided to use the processing factors derived from the dry milling of maize to

germ (0.32) and oil (18), applied to the STMR for cereal grain, to provide STMR-Ps for maize germ (0.224 mg/kg) and oil (12.6 mg/kg).

The mean processing factors for wheat to bran (3.3), flour (0.31), middlings (0.7), shorts (0.79), germ (1.2), wholemeal (0.91), white bread (0.14), wholemeal bread (0.42), flat bread (0.5), steamed bread (0.14), yellow alkaline noodles (0.17) and white noodles (0.13) when applied to the STMR for cereal grain, provide STMR-Ps for bran (2.31 mg/kg), flour (0.217 mg/kg), middlings (0.49 mg/kg), shorts (0.55 mg/kg), germ (0.84 mg/kg), wholemeal (0.637 mg/kg), white bread (0.098 mg/kg), wholemeal bread (0.294 mg/kg), flat bread (0.35 mg/kg), steamed bread (0.098 mg/kg), yellow alkaline noodles (0.119 mg/kg) and white noodles (0.091 mg/kg).

The Meeting recommended maximum residue levels of 5 mg/kg for wheat bran, 0.3 mg/kg for wheat flour and 2 mg/kg for wholemeal flour. In recommending a maximum residue level of 2 mg/kg for wholemeal flour the Meeting noted that deltamethrin residues do not decline significantly during storage and does not degrade during milling of grain to wholemeal flour, therefore the recommendation is at the same level as for cereal grain. The recommendation of 5 mg/kg for wheat bran confirms the previous recommendation while those for wheat flour (0.3 mg/kg) and wholemeal flour (2 mg/kg) replace the previous recommendations of 0.2 and 1 mg/kg, respectively.

The processing factors for sorghum grain to flour (0.33) and starch (0.04) when applied to the STMR for cereal grain, provide STMR-Ps for flour (0.231 mg/kg) and starch (0.028 mg/kg).

Farm animal dietary burden

The Meeting estimated the farm animal dietary burden of deltamethrin residues using the diets in Appendix IX of the FAO Manual. The calculation from the MRLs provides the feed levels suitable for animal commodity MRL estimation, while the calculation from feed STMRs is suitable for estimation of animal commodity STMRs. DM is dry matter. The % DM is taken as 100% where MRLs and STMRs are already expressed on a dry weight.

Commodity	**Group**	**% DM**		**Choose diets, %**			**Residue contribution, mg/kg**		
	MRL (or HR)		**MRL ÷ DM**	**Beef**	**Dairy**	**Poultry**	**Beef**	**Dairy**	**Poultry**
Apple pomace wet	0.17 (ST-P) AB	40	0.425		20			0.085	
Carrot culls	0.02 VR	12	0.167		10			0.0167	
Barley grain	2 GC	88	2.27						
Corn grain	2 GC	88	2.27	10			0.227		
Corn aspirated grain fractions	21.7 CF	85	25.5	20	20		5.1	5.1	
Corn milled by-products	0.539 CF	85	0.63						
Millet grain	1 GC	88	1.14						
Oats grain	2 GC	89	2.24						
Pea field	1 VD	90	1.11						
Rape forage	0.56 AM	30	1.87	20	30		0.374	0.561	
Lupin	1 VD	88	1.14						
Potato culls	0.01 VR	20	0.05						
Rice grain	2 GC	88	2.27						
Rice hulls	3.15 (ST-P) CM	90	3.5	10	10	15	0.35	0.35	0.525
Rice bran	1.05 (ST-P) CM	90	1.17						
Rye grain	2 GC	88	2.27						
Sorghum	2 GC	86	2.33	40	10	35	0.932	0.233	0.8155
Soy bean	1 VD	89	1.12						
Wheat grain	2 GC	89	2.24						
Wheat milled by products	2.31 CF	88	2.625			50			1.31
TOTAL				100	100	100	**7.0**	**6.3**	**2.65**
Commodity	**STMR**		**STMR ÷ DM**						
Apple pomace wet	0.17 AB	40	0.425		20			0.085	

Carrot culls	0.01	VR	12	0.08						
Barley grain	0.7	GC	88	0.80						
Corn grain	0.7	GC	88	0.80	10	10		0.08	0.08	
Corn aspirated grain fractions	21.7	CF	85	25.5	20	20		5.1	5.1	
Corn milled by-products	0.539	CF	85	0.63						
Millet grain	0.5	GC	88	0.57						
Oats grain	0.7	GC	89	0.79						
Pea field	0.5	VD	90	0.56						
Rape forage	0.14	AM	30	0.47	20	30		0.094	0.141	
Lupin	0.5	VD	88	0.57						
Potato culls	0.01	VR	20	0.05						
Rice grain	0.7	GC	88	0.80						
Rice hulls	3.15	CM	90	3.5	10	10	15	0.35	0.35	0.525
Rice bran	1.05	CM	90	1.2						
Rye grain	0.7	GC	88	0.80						
Sorghum	0.7	GC	86	0.81	40	10	35	0.324	0.081	0.2835
Soy bean	0.5	VD	89	0.56						
Wheat grain	0.7	GC	89	0.79						
Wheat milled by products	2.31	CF	88	2.6			50			1.3
TOTAL					100	100	100	**5.9**	**5.8**	**2.1**

Maize aspirated grain fractions PF for impurities = 31, STMR = 31×0.7 = 21.7 mg/kg.

Corn milled by-products used de-germed maize (dry-milled) PF = 0.77, STMR-P 0.77×0.7 = 0.539 mg/kg.

The deltamethrin dietary burdens for animal commodity MRL and STMR estimation (residue levels in animal feeds expressed on dry weight) are: beef cattle 7.0 and 5.9 ppm, dairy cattle 6.3 and 5.8 ppm and poultry 2.7 and 2.1 ppm.

Farm animal feeding studies

The Meeting received information on the residue levels arising in animal tissues and milk when dairy cows were dosed with deltamethrin for 28 days at the equivalent of 2 and 10 ppm in the diet. Residues in milk reached a plateau by day 4. Deltamethrin residues in the fat were higher than in other tissues. Transfer factors (residue level in tissue ÷ residue level in feed) for each tissue and milk for the two dosing levels (2 and 10 ppm respectively, single animals) were: fat, 0.023, 0.027; muscle, <0.015, <0.003; kidney, residues not reported due to analytical problems; liver, <0.015, <0.003; milk 28 days, 0.008, 0.0035.

In an additional study lactating dairy cows were administered a 1:1 mixture of deltamethrin and tralomethrin for 28 days at the equivalent of 2, 6 and 20 ppm in the diet and the residue levels arising in animal tissues and milk reported. Tralomethrin is rapidly converted to deltamethrin and the study can be used to provide information on likely residues on exposure to deltamethrin at 2, 6 and 20 ppm in the feed. As with the study above, residues in the fat were higher than in other tissues. Transfer factors (residue level in tissue ÷ residue level in feed) for each tissue and milk for the three dosing levels (2, 6 and 20 ppm respectively) were: fat, 0.006, 0.003, 0.001, mean 0.003; muscle, <0.005, <0.002, <0.0005, mean <0.0025; kidney, <0.005, <0.002, <0.0005, mean <0.0025; liver, <0.005, <0.002, <0.0005, mean <0.0025; milk 28 days, <0.005, <0.002, <0.0005, mean <0.0025, milk fat 28 days, 0.02, 0.005, 0.001, mean 0.009.

The Meeting received information on the residue levels arising in animal tissues when pigs were fed deltamethrin in the diet for 130-141 days at 0.67 ppm. Residues in the fat were higher than in other tissues. Transfer factors (residue level in tissue ÷ residue level in feed) for each tissue (fat, muscle, liver and kidney) were all <0.04.

The Meeting received information on the residue levels arising in tissues and eggs when laying hens and chickens were fed deltamethrin in the diet for up to 70 days in the case of chickens and for 20 weeks in the case of laying hens. Residues were below the LOQ of the analytical methods for tissues and eggs.

The Meeting also received information on the residue levels arising in tissues and eggs when laying hens were dosed with a 1:1 mixture of deltamethrin and tralomethrin for 28 days at the equivalent of 2, 6 and 20 ppm in the diet. At the 2 ppm feeding level the residues were below the LOQ of the analytical methods. Residues in fat were substantially higher than residues in other tissues and eggs. Residue levels in muscle and liver were below the LOQ of the analytical methods for all the dosing groups. Transfer factors based on highest residues for fat were <0.05, 0.04 and 0.03 respectively for the 2, 6 and 20 ppm feeding levels (<0.05, 0.02, 0.02 if means are used). Transfer factors (based on highest and mean residue) for muscle and liver were <0.01, <0.003 and <0.001 respectively for the 2, 6 and 20 ppm feeding levels. Residues in eggs reached a plateau by day 10 in the highest dose group. Residues in eggs were generally below the LOQ (0.01 mg/kg) for the other dose groups. The transfer factors (based on highest and mean residue) for eggs were <0.0075, <0.003 (at 7 days) and 0.002 (at 21 days) respectively for the 2, 6 and 20 ppm feeding levels.

Farm animal direct treatment

No studies were received on the residues of deltamethrin arising from direct animal treatment. The Meeting noted that JECFA has evaluated deltamethrin residues arising from direct animal treatment at its 52nd Meeting in 1999 and recommended maximum residue limits for cattle, sheep and chickens of 30 μg/kg for muscle, milk and eggs, 50 μg/kg for liver and kidney and 500 μg/kg for fat. The muscle maximum residue limit also applies to salmon. The marker residue that applied to the residue limits was deltamethrin. The 52nd JECFA noted that no residues were detected in muscle, milk and eggs of treated animals/hens in residue depletion studies.

Animal commodity maximum residue levels

The Meeting decided to utilise the published feeding with dairy cattle where significantly higher residues (in-line with the lactating cow metabolism study on deltamethrin and feeding studies with related pyrethroids) rather than the tralomethrin/deltamethrin feeding study to estimate maximum residue levels for mammalian commodities. The maximum dietary burden for beef and dairy cattle is 7.0 mg/kg, so the levels of residues in tissues and milk can be obtained by interpolation between the high residues obtained in tissues at the 2 and 10 ppm feeding levels. Maximum residues expected in tissues are: fat 0.19 mg/kg, muscle <0.03 mg/kg, liver <0.03 mg/kg and the mean residue for milk 0.018 mg/kg.

The Meeting estimated maximum residue levels for meat (from mammals other than marine mammals) 0.5 mg/kg (fat); kidney of cattle, goats, pigs and sheep 0.03 (*) mg/kg; liver of cattle, goats, pigs and sheep 0.03 (*) mg/kg and milks 0.05 mg/kg. The recommendation of 0.5 mg/kg (fat) for meat (from mammals other than marine mammals) replaces the previous recommendation at the same level that also incorporated direct animal uses while the recommended levels for kidney and liver of cattle, goats, pigs and sheep at 0.03* mg/kg replace the previous recommendation of 0.05 mg/kg for edible offal (mammalian).

The STMR dietary burden for beef and dairy cattle is 5.9 mg/kg (mean of 5.9 and 5.8 mg/kg). The Meeting interpolated STMR values from the high residues in each feeding level. The high residue in each feeding level was used to interpolate STMR values as for deltamethrin only a single animal was slaughtered at 24 hours after the last dose. The additional animals slaughtered at 4 and 9 days after the last dose also had significant residues in fat and provided confidence in the procedure used. The estimated STMRs were: meat (from mammals other than marine mammals) <0.03 mg/kg, fat (from mammals other than marine mammals) 0.16 mg/kg, kidney of cattle, goats, pigs and sheep <0.03 mg/kg, liver of cattle, goats, pigs and sheep <0.03 mg/kg and milks 0.017 mg/kg.

The highest individual tissue residue from the relevant feeding group was used in conjunction with the highest residue dietary burden to calculate the likely highest animal commodity residue level. As only a single animal is available per feeding group, these tissue residues from the animals in the relevant feeding groups were used in conjunction with the STMR dietary burden to estimate the animal commodity STMR values. For milk the mean milk residue at the plateau level from the relevant feeding group was used to estimate both the maximum residue level and the STMR.

Dietary burden (mg/kg)[1]		Deltamethrin residues, mg/kg[3]								
Feeding level [ppm][2]		Milk	Fat		Muscle		Liver		Kidney	
		Mean	high	mean	High	mean	high	mean	High	mean
MRL beef	(7.0) [10]		*(0.186)* 0.27		*(<0.03)* <0.03		*(<0.03)* <0.03		*(<0.03)*[4]	
MRL dairy	(6.3) [10]	*(0.018)* 0.026								
STMR beef	(5.9) [10]		*(0.155)* 0.27		*(<0.03)* <0.03		*(<0.03)* <0.03		*(<0.03)*[4]	
STMR dairy	(5.8) [10]	*(0.017)* 0.026								

[1] Values in parentheses are the estimated dietary burdens
[2] Values in square brackets are the actual feeding levels in the transfer study
[3] Residue values in parentheses in italics are interpolated from the dietary burden, feeding levels in the transfer study and the residues found in the transfer study. High is the highest individual animal tissue residue in the relevant feeding group. Mean is mean animal tissue (or milk) residue in the relevant feeding group.
[4] The lactating goat metabolism study suggests residues in kidney will be below the limit of analytical quantitation

The maximum dietary burden for poultry is 2.7 mg/kg. The levels of residues in tissues and eggs can be obtained from interpolation between the 2 and 6 ppm feeding levels. Maximum residues expected are: muscle <0.02 mg/kg, fat 0.09 mg/kg, liver <0.02 mg/kg, eggs <0.02 mg/kg.

The Meeting estimated maximum residue levels for poultry meat 0.1 mg/kg (fat); poultry offal 0.02* and eggs 0.02 (*) mg/kg to replace previous recommendations of 0.01* for poultry meat and poultry edible offal and 0.01* mg/kg for eggs.

As no residues are observed at the maximum feeding level for poultry, the STMRs for poultry edible offal and eggs are the same as the maximum residue levels. The STMR for poultry meat (fat) is 0.038 mg/kg based on a median residue of 0.11 mg/kg for fat at a feeding level of 6 ppm and a dietary burden of 2.1 ppm.

RECOMMENDATIONS

On the basis of the data from supervised trials the Meeting concluded that the residue levels listed below are suitable for establishing maximum residue limits and for IEDI assessment.

Definition of the residue (for compliance with MRL and for estimation of dietary intake): *sum of deltamethrin, α-R- and trans–deltamethrin ([1R-[1α(R*),3α]]-3-(2,2-dibromoethenyl)-2,2-dimethyl-cyclopropanecarboxylic acid, cyano(3-phenoxyphenyl)methyl ester and [1R-[1α(S*),3β]]-3-(2,2-dibromoethenyl)-2,2-dimethyl-cyclopropanecarboxylic acid, cyano(3-phenoxyphenyl)methyl ester)*..

The residue is fat-soluble

Commodity		MRL, mg/kg		STMR or STMR-P	HR or HR-P
CCN	Name	New	Previous		
FP 0226	Apple	0.2	-	0.03	0.08
JF 0226	Apple juice	-	-	0.0027	-
VR 0577	Carrot	0.02	-	0.01	0.02
FC 0001	Citrus fruits	0.02	-	0.01	0.01
VS 0620	Artichoke, globe	W	0.05	-	-
FI 0327	Banana	W	0.05	-	-
VD 0071	Beans (dry)	W	1 P_O		
VB 0040	Brassica vegetables	W	0.2	-	-
VA 0036	Bulb vegetables, except fennel, bulb	W	0.1	-	-
SB 0715	Cacao beans	W	0.05	-	-
GC 0080	Cereal grains	2 P_O	1 P_O	0.7	1.1
SB 0716	Coffee beans	W	2 P_O	-	-
MO 0105	Edible offal (mammalian)	W	0.05		
PE 0112	Eggs	0.02 (*)	0.01 (*)	0.02	0.02
VD 0561	Field pea (dry)	W	1 P_O		
FT 0297	Fig	W	0.01 (*)	-	-
VB 0042	Flowerhead brassicas	0.1	-	0.02	0.04
VO 0050	Fruiting vegetables, other than cucurbits (except mushrooms)	W	0.2	-	-
VC 0045	Fruiting vegetables, cucurbits	0.2	0.2	0.02	0.09
FB 0269	Grapes	0.2	0.05	0.04	0.09
TN 0666	Hazelnuts	0.02 (*)	-	0.02	0.02
DH 1100	Hops, dry	W	5	-	-
FI 0341	Kiwifruit	W	0.05	-	-
VL 0053	Leafy vegetables	2	0.5	0.125	1
VA 0384	Leek	0.2	-	0.07	0.13
VP 0060	Legume vegetables	0.2	0.1	0.01	0.14
AL 0157	Legume animal feeds	W	0.5 dry wt	-	-
VD 0533	Lentil (dry)	W	1 P_O		
MO 0099	Liver of cattle, goats, pigs and sheep	0.03*		0.03	0.03
MO 0098	Kidney of cattle, goats, pigs and sheep	0.03*		0.03	0.03
FC 0003	Mandarins	W	0.05		
MM 0095	Meat (from mammals other than marine mammals)	0.5 (fat)	0.5 (fat)	0.155	0.186
VC 0046	Melons, except watermelon	W	0.01 (*)		
ML 0106	Milks	0.05	0.02 F	0.017	0.018
VO 0450	Mushrooms	0.05	0.01 (*)	0.02	0.03
FS 0245	Nectarine	0.05	-	0.02	0.05
SO 0088	Oilseed	W	0.1		
SO 0089	Oilseed except peanut	W	0.1		
FT 0305	Olives	1	0.1	0.21	0.31
OC 0305	Olive oil, virgin			0.315	
OR 0305	Olive oil, refined			0.336	
VA 0385	Onion, Bulb	0.05	-	0.02	0.03
FC 0004	Oranges, Sweet, Sour	W	0.05	-	-

Commodity		MRL, mg/kg		STMR or STMR-P	HR or HR-P
CCN	Name	New	Previous		
FS 0247	Peach	0.05	-	0.02	0.05
SO 0697	Peanut	W	0.01 (*)	-	-
FI 0353	Pineapple	W	0.01 (*)	-	-
FS 0014	Plums (including prunes)	0.05	-	0.02	0.05
FP 0009	Pome fruit	W	0.1	-	-
VR 0587	Potato	0.01 (*)	-	0.01	0.01
PM 0110	Poultry meat	0.1 F	0.01 (*)	0.038	0.09
PO 0111	Poultry, edible offal of	0.02 (*)	0.01 (*)	0.02	0.02
VD 0070	Pulses	1 P_O	-	0.5	0.85
VR 0494	Radish	0.01 (*)	-	0.01	0.01
VR 0075	Root and tuber vegetables	W	0.01	-	-
FS 0012	Stone fruits	W	0.05	-	-
AS 0081	Straw and fodder (dry) of cereal grains	W	0.5	-	-
FB 0275	Strawberry	0.2	0.05	0.02	0.1
SO 0702	Sunflower seed	0.05 (*)	-	0.05	0.05
VO 0447	Sweet corn (corn-on-the-cob)	0.02 (*)	-	0.02	0.02
DT 1114	Tea, Green, Black	5	10	2.2	3.1
VO 0448	Tomatoes	0.3	-	0.02	0.2
FT 0312	Tree Tomato	W	0.02	-	-
TN 0678	Walnuts	0.02 (*)	-	0.02	0.02
CM 0654	Wheat bran, unprocessed	5 P_OP	5 P_OP	2.31	
CF 1211	Wheat flour	0.3 P_OP	0.2 P_OP	0.217	
CF 1212	Wheat wholemeal	2 P_OP	1 P_OP	0.637	

* the MRL is estimated at or about the LOQ

DIETARY RISK ASSESSMENT

Deltamethrin was evaluated by the 52nd JECFA for residues in animal commodities arising from direct animal treatment. In the case of animal commodities, the maximum residue limit recommendations of the 52nd JECFA for cattle, sheep and chicken were the same or higher than those recommended above. The residue definition (marker residue) chosen by JECFA was deltamethrin.

As the major proportion of the consumption for animal commodities comes from cattle, sheep and chickens, the Meeting decided to translate the MRL recommendations of JECFA to the recommendations above and use them in the short and long-term dietary intake calculations below. For example, the JECFA recommendations for fat, liver, kidney, muscle and milk of cattle and sheep are translated to MRL/HR inputs in the dietary intake calculations for meat (from mammals other than marine mammals), liver and kidney of cattle, goats, pigs and sheep and milks. Similarly the JECFA recommendations for chicken fat, muscle, liver, kidney and eggs translate to poultry meat, poultry edible offal and eggs.

Chronic intake

The evaluation of deltamethrin has resulted in recommendations for MRLs and STMRs for raw and processed commodities. Consumption data were available for 50 food commodities and were used in the dietary intake calculation. The results are shown in Annex 3.

The International Estimated Daily Intakes for the 5 GEMS/Food regional diets, based on estimated STMRs were in the range 20-30% of the ADI of 0-0.01 mg/kg bw (Annex 3). The Meeting concluded that the long-term intake of residues of deltamethrin from uses that have been considered by the JMPR is unlikely to present a public health concern.

Short-term intake

The international estimated short-term intake (IESTI) for deltamethrin was calculated for the food commodities (and their processing fractions) for which maximum residue levels and HRs were estimated and for which consumption data were available. Where group MRLs were recommended and the IESTI calculation involved a variability factor (e.g. citrus fruits, leafy vegetables) the IESTI was calculated for both the commodities with the highest consumption figure and with the largest unit weight to ensure the IESTI calculation covered the highest intake. Where group MRLs were recommended and the IESTI calculation was for case 1 or 3 (no variability factor) the IESTI was calculated only for the commodity with the highest consumption figure as this covers the highest intake situation for a commodity in that group. The results are shown in Annex 4.

The IESTI varied from 0-58 % of the acute RfD (0.05 mg/kg bw) for the general population. The IESTI varied from 0-130% of the acute RfD for children. The short-term intake for the leafy vegetables, for which the calculation was made, was 115-130% of the acute RfD for children.

The Meeting concluded that the short-term intake of residues of deltamethrin from uses that have been considered by the JMPR, with the exception of leafy vegetables, is unlikely to present a public health concern.

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