BIFENTHRIN (178)

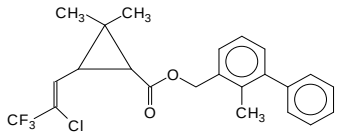
The first draft was prepared by Dr U Banasiak, Federal Institute for Risk Assessment, Berlin, Germany

EXPLANATION

Bifenthrin is a pyrethroid insecticide and miticide. It was first evaluated by the 1992 JMPR (T, R) and subsequently for residues a number of times. Bifenthrin was evaluated for toxicology by the 2009 JMPR within the periodic review programme of the CCPR. The periodic review for residues was scheduled at the 41st session of the CCPR for the 2010 JMPR.

The current Meeting received information from the manufacturer on physical and chemical properties, metabolism studies on plants and animals, environmental fate in soil, crop rotation, analytical methods, supervised trial data, processing studies, feeding studies as well as use pattern. Information on GAP was submitted by Australia and Japan. Residue data for mango, papaya and okra were provided by Ghana and Ivory Cost.

IDENTITY

Common name:	Bifenthrin
Chemical name:	
IUPAC:	2-methylbiphenyl-3-yl-methyl (Z)-(1 RS,3RS)-3-(2-chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethyl-cyclopropanecarboxylate
CA (index):	(2-methyl[1,1'-biphenyl]-3-yl)methyl3-[(1*Z*)-2-chloro-3,3,3-trifluoro-1-propenyl)-2,2- dimethylcyclopropanecarboxylate
CAS number:	cis-82657-04-3; trans-83322-02-5
CIPAC number:	not assigned
Molecular formula:	$C_{23}H_{22}ClF_3O_2$
Structural formula:	
Isomers:	Bifenthrin is a mixture of the E- and the Z-isomer with a Z/E-ratio of 99.67% Z bifenthrin/0.33% E bifenthrin. Bifenthrin can be present as a cis-isomer and a trans-isomer. The ration of cis- to trans-isomers is typically 98.65:1.35 (specification: 97% cis minimum : 3% trans maximum).
Molecular mass:	422.88
Minimum purity:	active substance (ai) manufactured 930 g/kg

FORMULATIONS

Bifenthrin is available in numerous commercial formulations in many countries. It is available in a range of formulation types: EC, FS, GR, ME, SC, ST, WP, UL, ULV.

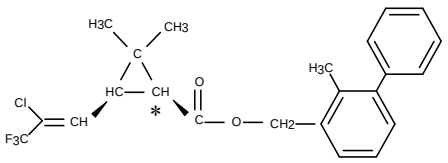
PHYSICAL AND CHEMICAL PROPERTIES

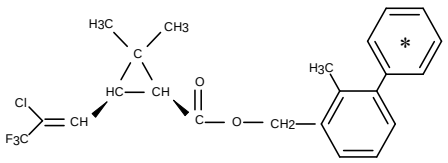
Property	Results	Report No, Reference
Appearance/Physical state	Beige to white waxy or crystalline solid (technical material); Crystalline solid (pure material)	P-2544, Lee 1991
Colour	Off-white to pale tan	P-2544, Lee 1991
Odour	Very weak, aromatic	P-2544, Lee 1991
Melting point	68.9–70.2 °C	P-17-04-22, Brachet 2004
Boiling point	Decomposes before boiling	P-17-04-22, Brachet 2004
Thermal stability	Decomposition starts at 168.3 °C	P-17-04-22, Brachet 2004
Relative density	1.42 g/cm^3 at 20 °C	P-17-04-22, Brachet 2004
Vapour pressure	1.78×10^{-5} Pa at 20 °C	P-17-04-22, Brachet 2004
Henry's law constant	3.01 Pa m^3 mol^{-1}	P-17-04-22, Brachet 2004
Solubility in water	0.014 µg/L	P-0699, Herbst 1983
Solubility in organic solvents	Methanol 48.0 mg/L, xylene 556.3 mg/L, acetone 735.7, 1,2-dichloroethane 743.2, ethyl acetate 579.8, n-heptane 144.5- all at 20 ºC	PML 2002-C121, Spruit *et al*. 2002
Octanol/water partition co-efficient	Log Pow 7.3	P-17-04-22, Brachet 2004
Hydrolysis rate	Bifenthrin does not hydrolyse	P-0701, Herbst 1983
Photo-transformation	Phototransformation half-live was 8.8–14.2 days with a filtered Xenon lamp. Pathway includes isomerisation of the cis- to trans-isomer and cleavage of the ester to form the major photodegradation product, biphenyl alcohol.	PC-0473, Schick 2009
Quantum yield of direct photo-transformation	0.0107	PC-0473, Schick 2009
Flash point	> 110 °C	PML 2002-C121, Spruit *et al*. 2002

METABOLISM AND ENVIRONMENTAL FATE

The metabolism and distribution of bifenthrin in plants and animals was investigated using the trifluoromethoxyphenyl-U-^{14}C- and benzonitrile-U-^{14}C-labelled compound.

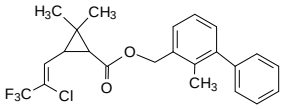
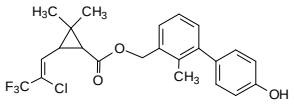
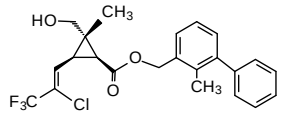
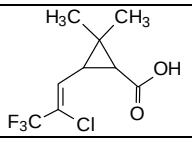
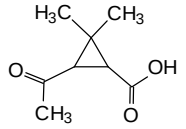
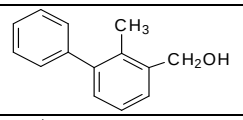
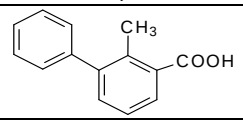
The fate and behaviour of metaflumizone in the environment was investigated using the trifluoromethoxyphenyl-U-^{14}C-, benzonitrile-U-^{14}C- and trifluoromethylphenyl-U-^{14}C-labelled compound.





Cyclopropyl (CP) label Phenyl (PH) label

Chemical names, structures and code names of metabolites and degradation products of bifenthrin are summarised below.

FMC Number [CAS No.]	Common Name	Chemical Name	Structure
FMC54800 [82657-04-3]	Bifenthrin	[2-Methyl-(1,1'biphenyl)-3-yl]-methyl-*cis,trans*-3-(2-chloro-3,3,3-trifluoro-1-propenyl)-2,2-dimethyl-cyclopropane-carboxylate	
FMC78128 [115404-73-4]	4'OH-bifenthrin	3-(4'Hydroxyphenyl)-2-methylphenyl-methyl-*cis,trans*-3-(2-chloro-3,3,3-trifluoro-1-propenyl)-2,2-dimethyl-cyclopropanecarboxylate	
FMC 108561 [CAS not available]	Hydroxymethyl-bifenthrin	2-Methyl-[1,1'biphenyl]-3- yl)-methyl-*cis*-3-(2-chloro- 3,3,3-trifluoro-1-propenyl) *trans*-2-hydroxymethyl2- methyl-cyclopropane-carboxylate	
FMC53998 [72748-35-7]	TFP acid	*cis*-trans-3-(2-chloro-3,3,3-trifluoro-1-propenyl)-2,2-dimethyl-cyclopropane- carboxylic acid	
FMC 87031 [CAS not available]	Acetyl-cyclopropane carboxylic acid	*cis*-trans-3-acetyl-2,2-dimethyl-cyclopropane- carboxylic acid	
FMC56789 [76350-90-8]	Biphenyl alcohol (BP alcohol)	2-methyl-3-phenylbenzyl alcohol	
FMC65328 [I15363-11-6]	Biphenyl acid (BP acid)	2-methyl-3-phenylbenzoic acid	

Animal metabolism

The metabolism of bifenthrin has been studied in laboratory rats, goats and hens.

Rats

Rat metabolism studies were evaluated by the WHO Core Assessment Group of the 2009 JMPR. A summary of the rat metabolism is given in this section:

"Bifenthrin was metabolized via hydrolysis, oxidation and subsequent glucuronide conjugation. In the faeces, unchanged bifenthrin was the major component (17–45% of the administered radiolabel). Twelve other products derived from hydrolysis and oxidation of the parent compound was also detected in the faeces. Almost no parent compound was detectable in the urine. Nine metabolites derived from hydrolysis and hydrolysis–oxidation products of bifenthrin were detected in the urine."

Lactating goats

Four lactating goats were dosed twice daily by gelatine capsule with CP^{14}C (cyclopropyl ring-^{14}C) bifenthrin, or PH^{14}C (phenyl ring-^{14}C) bifenthrin at a daily nominal rate of 2 mg/kg body weight (2.3 mg/kg bw actual) for seven days (Predmore and Lawman 1984, PC-0021). The corresponding nominal/actual dietary equivalents were 50/79 ppm. Two animals were dosed with each label and one goat was assigned as control. Milk, urine, and faeces were collected twice daily for radio-analysis. The animals were sacrificed 24 hours after the last dose to obtain tissue and organ samples for radio-analysis. The analysis was performed by liquid scintillation counting (LSC).

The milk samples were extracted with acetonitrile partitioned with hexane and further analysed by GPC, TLC HPLC, and liquid scintillation counting. Control milk samples were fortified with PH-^{14}C bifenthrin at nominal rates of 3.6 mg/kg and 7.7 mg/kg to determine percent recovery of parent compound through the method (El Naggar 1984, P-1014). Samples of individual tissues (perirenal fat, quadriceps muscle, heart muscle, kidney, liver) were taken and analysed (El Naggar 1986, P-1367). Fat was extracted with hexane and partitioned with acetonitrile. Quadriceps and heart muscle as well as kidney and liver were extracted with acetone and partitioned with acetonitrile/hexane. For kidney and liver the PES (Post-Extraction Solids) were further extracted with methanol and the extract subjected to enzyme hydrolysis. The remaining solids were subjected to acid hydrolysis. Analysis was performed by GPC, TLC HPLC, and liquid scintillation counting. The bifenthrin equivalent residues in milk, excreta and tissues are summarised in Table 1.

Table 1 TRR as bifenthrin equivalents in milk, excreta and tissues (PC-0021, P-1014, P-1367)

Matrix Study day		^{14}C Radioactivity (mg/kg) CP label		PH label		Control
Milk						
(-1)	AM	-	-	-	-	-
	PM	-	-	-	-	-
1	AM	-	-	-	-	-
	PM	0.068	0.64	0.18	0.15	-
2	AM	0.52	1.20	0.41	0.54	-
	PM	0.60	0.67	0.54	0.72	-
3	AM	0.41	0.33	0.91	0.67	-
	PM	0.52	0.58	0.66	0.67	-
4	AM	1.00	0.69	0.83	1.00	-
	PM	0.83	0.91	0.86	0.97	-
5	AM	1.50	1.40	0.84	0.94	-
	PM	0.80	1.40	0.84	1.00	-
6	AM	0.78	1.00	1.10	0.88	-
	PM	0.67	1.00	0.84	0.85	-
7	AM	0.85	1.40	0.79	1.20	-
	PM	0.74	0.63	0.82	1.10	-
8	AM	0.54	0.65	0.66	0.81	-
Faeces						
(-1)		-	-	-	-	-
1		6	21	10	10	-
2		53	57	64	65	-
3		68	22	91	69	-
4		110	41	90	78	-
5		130	60	83	73	-
6		110	59	98	77	-
7		170	50	10	88	-
Urine						
(-1)		-	-	-	-	-
1		5.8	8.7	6.3	3.0	-
2		6.1	2.3	12.0	8.2	-
3		12.0	2.8	11.0	7.3	-
4		17.0	4.5	11.0	6.7	-
5		15.0	5.6	11.0	5.8	-
6		20.0	8.4	12.0	8.6	-
7		20.0	3.2	14.0	7.6	-

Matrix / Study day		^{14}C Radioactivity (mg/kg) CP label		PH label		Control
Fat						
	Omental	1.70	2.00	1.70	1.30	< 0.008
	Perirenal	1.80	2.30	2.80	1.80	< 0.008
	Subcutaneous	1.00	0.71	0.73	1.20	< 0.008
Muscle						
	Deltoid	0.23	0.26	0.22	0.35	< 0.008
	Flank	0.33	0.24	0.25	0.28	< 0.010
	Quadriceps	0.26	0.49	0.22	0.26	< 0.009
Heart		0.62	0.54	0.42	0.53	< 0.008
Kidney		0.46	0.32	1.00	0.53	< 0.009
Liver		2.50	1.60	3.30	3.90	< 0.009

The average ^{14}C residue distribution in milk extract fractions as well as the percent distribution of ^{14}C bifenthrin and metabolites in composite GPC fractions from samples of the Predmore, Lawman study (PC-0021) are shown in Table 2 (El Naggar 1984, P-1014). Only the acetonitrile fraction but not the hexane fraction and the PES fraction were analysed in this study. Almost 90% of the residues were acetonitrile extractable and the only major product identified was the parent compound bifenthrin.

Table 2 Average percent ^{14}C residue distribution in milk extract fractions, acetonitrile phase (P-1014)

Extraction fraction	PH-^{14}C (% ± SD)	CP-^{14}C (% ± SD)	Product distribution (%± SD) Product	TLC PH-^{14}C	TLC CP-^{14}C	HPLC PH-^{14}C	HPLC CP-^{14}C
Acetonitrile	89.6 ± 3.7	91.1 ± 1.6	bifenthrin	93.1 ± 2.5	98.2 ± 0.3	93.5 ± 2.3	98.0 ± 0.3
			unidentified	6.9 ± 2.5[b]	1.8 ± 0.3[b]	6.5 ± 2.3[c]	2.0 ± 0.3[c]
Hexane	6.1 ± 2.2	4.9 ± 1.5	NA [a]				
PES	4.3 ± 1.5	4.0 ± 0.2	NA				
Total	100	100		100	100	100	100

[a] NA = Not analysed

[b] Analysis of PH-^{14}C residues showed 5 unknowns none exceeding 4.3%. CP-^{14}C analysis showed one unknown product

[c] Analysis of PH-^{14}C residues showed 5 unknowns none exceeding 4.7%. CP-^{14}C analysis showed one unknown product

The ^{14}C distribution among the major fractions was similar with the two labels (El Naggar 1986, P-1367). Table 3 summarises the distribution among the fractions (average of CP and PH labels). It shows that most of the ^{14}C residue in milk and tissues was in the acetonitrile fraction although in kidney and liver significant residues were also found in the hexane fraction and post-extraction solids. The acetonitrile fraction was cleaned up by GPC most of the ^{14}C being in the later GPC fractions and analysed by HPLC and TLC.

Table 3 Distribution of the average CP- and PH-^{14}C residues among analytical fractions from goat feeding studies (P-1367)

Fraction	Milk	Perirenal fat		Quadriceps muscle		Heart muscle		Kidney		Liver	
	%	%	mg/kg[a]	%	mg/kg[a]	%	mg/kg[a]	%	mg/kg[a]	%	mg/kg[a]
Acetonitrile	90.4	86.3	1.9	90.4	0.28	89.8	0.46	60.2	0.36	69.3	2
Hexane	5.5	13.7	0.3	7.2	0.02	9.3	0.05	14.5	0.08	9.4	0.26
PES	4.2			2.6	0.01	2.9	0.02				
Methanol [b]								14.2	0.08	3.7	0.13
Ethyl acetate [c]								2.3	0.01	2.1	0.05
Polar aqueous [d]								3.2	0.02	6.3	0.17
Bound [e]								5.7	0.03	9.1	0.24

[a] Expressed as bifenthrin

[b] Methanol extract of post-extraction solids

[c] Ethyl acetate extract of HCl-hydrolysed solids after methanol extraction

[d] Polar aqueous fraction of solids after ethyl acetate extraction

[e] Unextracted residues from solids

Table 4 shows the identity and distribution of residues found in the acetonitrile fraction from the milk, fat, and muscle tissues and table 5 from kidney and liver for both the acid and the alcohol labels as determined by HPLC and TLC analyses.

Table 4 Parent and metabolites in milk and tissues of goats in the acetonitrile fraction (P-1367)

Product	Milk [a]		Perirenal fat		Quadriceps muscle		Heart muscle	
	%TRR [b]	mg/kg [c]	%TRR [b]	mg/kg [c]	%TRR [b]	mg/kg [c]	%TRR [b]	mg/kg [c]
Bifenthrin								
PH-^{14}C	71.5	0.70	77.6	1.8	74.2	0.2	76.3	0.4
CP-^{14}C	82.4	1.1	80.2	1.6	87.6	0.3	77.3	0.5
BP-acid								
PH-^{14}C	0.6	0.001						
CP-^{14}C	NA[d]	NA						
BP-alcohol								
PH-^{14}C	0.6	0.003	1.2	0.013	1.3	0.002	0.1	< 0.001
CP-^{14}C	NA	NA	NA	NA	NA	NA	NA	NA
4'-OH-bifenthrin								
PH-^{14}C	1.3	0.013	1.5	0.04	1.0	0.002	1.1	0.01
CP-^{14}C	ND[e]	ND	1.0	0.02	ND	ND	0.2	0.001
OH-methyl-bifenthrin								
PH-^{14}C	2.7	0.03	1.6	0.04	5.0	0.01	3.8	0.02
CP-^{14}C	1.5	0.02	1.9	0.04	4.5	0.02	2.5	0.02
TFP acid								
PH-^{14}C			NA	NA			NA	NA
CP-^{14}C			0.7	0.01			0.8	0.003
Origin								
PH-^{14}C			0.7	0.02				
CP-^{14}C			1.0	0.02				
Unidentified								
PH-^{14}C	3.4	0.03			2.1	0.005	3.4	0.02
CP-^{14}C	ND	ND			ND	ND	3.8	0.02
Total								
PH-^{14}C	80.1		82.6		83.6		84.7	
CP-^{14}C	83.9		84.8		92.1		84.5	

[a] Seven-day composite for PH label and five day composite for CP label

[b] %TRR = % of total ^{14}C residues from PH and CP labels in milk and tissue

[c] Values for unknown metabolites and TLC origin (polar) expressed as bifenthrin

[d] NA = Not applicable

[e] ND or blank means not detected or no reference to a residue

Origin: any immobile radioactive material that does not move on the TLC plate. Typically they are very polar in nature and small in percentage

Table 5 Parent and metabolites in kidney and liver of goats in the acetonitrile fraction (P-1367)

Product	Kidney				Liver			
	PH-^{14}C		CP-^{14}C		PH-^{14}C		CP-^{14}C	
	% TRR[a]	mg/kg[b]	% TRR[a]	mg/kg[b]	% TRR[a]	mg/kg[b]	% TRR[a]	mg/kg[b]
Bifenthrin	16.2	0.12	21.5	0.08	19.2	0.7	44.1	0.9
BP-acid	35.1	0.14	NA [c]	NA	28.5	0.5	NA	NA
BP-alcohol	2.1	0.02	NA	NA	1.8	0.03	NA	NA
4'-OH-BP-alcohol	0.4	0.002	NA	NA				
4'-OH-bifenthrin	ND [d]	ND	2.7	0.01				
OH-methyl-bifenthrin	ND	ND	1.0	0.004	2.0	0.08	3.9	0.08
TFP acid	NA	NA	4.3	0.01	NA	NA	1.6	0.02
OH-methyl-TFP acid	NA	NA	2.7	0.01	NA	NA	1.6	0.02
Unidentified + origin	7.5	0.06	3.0	0.01	8.0	0.3	3.3	0.1
Total	61.3		35.2		59.5		54.5	

[a] % TRR = % of total residues from PH/CP label in organ

[b] Values for unknown metabolites expressed as bifenthrin

[c] NA = Not applicable

[d] ND or blank means not detected or no reference to a residue

Origin: any immobile radioactive material that does not move on the TLC plate. Typically they are very polar in nature and small in percentage

Lipid fractions from milk, perirenal fat, kidney, and liver yielded additional products when hydrolysed. The found products are summarised in Table 6. Enzyme and/or acid hydrolysis of kidney and liver PES yielded < 5% of the total residue. Highest of the free aglycones fraction was BP-acid and TFP acid from kidney amounting to approximately 5% each, and most other products found in kidney and liver being < 2%.

Table 6 Percent distribution of products from hydrolysis of lipid conjugates from milk, perirenal fat, kidney and liver (P-1367)

Product	Milk [a]		Perirenal Fat [b]		Kidney [b]		Liver [c]	
	PH-^{14}C	CP-^{14}C	PH-^{14}C	CP-^{14}C	PH-^{14}C	CP-^{14}C	PH-^{14}C	CP-^{14}C
Neutral fraction								
BP alcohol	12.6	NA	10.0	NA	3.5	NA	14.2	NA
BP aldehyde	0.3	NA	0.1	NA	0.1	NA		
Unidentified	0.9	ND	0.6	ND	0.4	NA	1.3	NA
Phenol/acid fraction								
OH-methyl-TFP acid	NA[d]	0.9	NA	4.3	NA	1.4	NA	6.8
4'-OH-BP-alcohol	ND [e]	NA	0.1	NA	0.9	NA		
BP-acid			0.2	NA	6.7	NA	2.1	NA
TFP acid	NA	8.8	NA	0.8	NA	13.9	NA	4.0
Polar unknowns			0.3	0.5	0.8	2.1	0.3	ND
Non-polar unknowns	1.0	1.3	1.9	1.3	3.3	5.6	0.6	0.9

[a] % total ^{14}C residues in day 4–7 saponified lipid fractions

[b] % total ^{14}C residues in saponified lipid fractions of perirenal fat or kidney respectively

[c] % of total ^{14}C tissue residue

[d] Not applicable

[e] ND or blank means not detected or no reference to a residue

Stability of bifenthrin under saponification conditions was investigated by El Naggar (1987, P-1607). Samples of chopped goat perirenal fat were spiked with a solution of radiolabelled bifenthrin. After addition of hexane and stirring, the mixture was filtered and the solution was evaporated. Two samples were treated with 20% KOH/ethanol and two samples with 6.7% KOH/ethanol. One sample each of the 20% treated solution and one of the 6.7% treated solution were refluxed for one hour, the other samples were refluxed for three hours. After this, the samples were again evaporated. Residues were re-dissolved in water and partitioned to dichloromethane. The resulting alkaline solutions were then acidified and again extracted with dichloromethane. The solutions containing acidic degradation products were dried over anhydrous sodium sulphate and concentrated. Subsequent analysis was done by TLC, HPLC, GC/MS, and NMR. The radiocarbon distributions of different fractions from base hydrolysis of CP-^{14}C bifenthrin in a lipid matrix are shown in Table 7. The results indicate that as the base concentration decreased, the portion of acidic hydrolysis products increased. The analyses of the acidic hydrolysates from experiments A, B, C, and D showed that TFP acid constituted 9.3%, 41.4%, 72.2%, and 70.7%, respectively, while acetyl-cyclopropane-carboxylic acid (ACC) constituted 63.8%, 28.1%, 6.4%, and 1.5% of the total recovered ^{14}C.

Table 7 Hydrolysis of CP-^{14} C-bifenthrin (P-1607)

Experiment	A	B	C	D
Base concentration [%]	20.0	20.0	6.7	6.7
Reflux duration [h]	3	1	3	1

Experiment	A	B	C	D
Neutral hydrolysates [%]	4.8	0.4	5.4	5.3
Acidic hydrolysates [%]	82.4	82.1	92.6	92.9
Aqueous degradates [%]	12.8	17.5	2.0	1.9
Total [%]	100.0	100.0	100.0	100.0
Recovery [%]	95.3	89.8	91.6	86.4
TFP acid [%]	9.3	41.4	72.2	70.7
ACC acid [%]	63.8	28.1	6.4	1.5
Total [%]	73.1	69.5	78.6	72.2
Recovery [%]	95.9	97.1	95.2	90.0

The proposed metabolic pathway of bifenthrin in goat is presented in Figure 1.

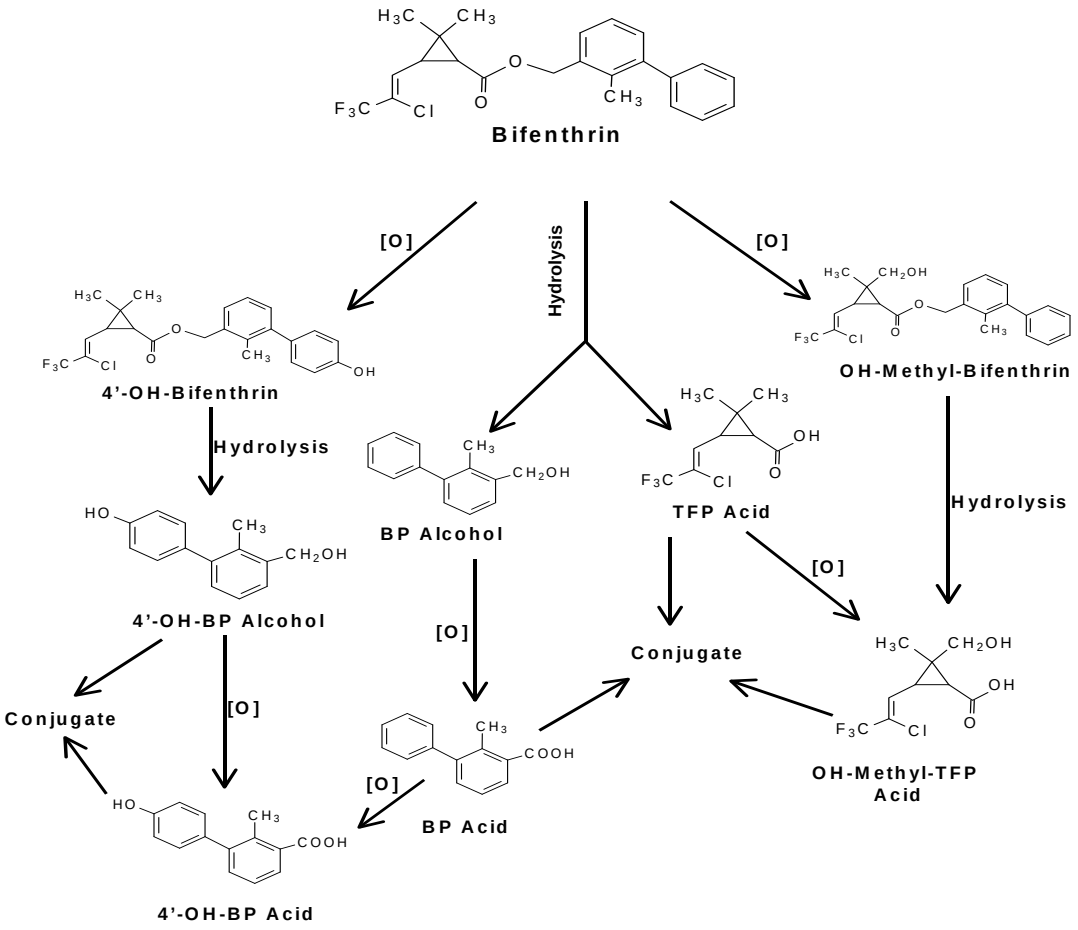


Figure 1 Proposed metabolic pathway of bifenthrin in goats

Laying hens

The absorption, distribution, excretion of bifenthrin in laying hens was studied by Jameson and Shaffer (1986, PC-0046). Forty laying hens, divided in 2 treatment groups of 20 hens each, were orally dosed for 10 days with encapsulated ^{14}C bifenthrin labelled either in the CP or PH position at a nominal dietary equivalent of 40 ppm (actual 31 ppm). The nominal dose by weight was 2 mg/kg bodyweight. Eggs were collected and weighed each day and the yolk and white were pooled

separately. Excreta were collected on days 8, 9 and 10 of the study and were pooled by treatment group. At the end of the study the animals were killed within 24 hours of the last dose for tissue analysis. Each tissue type was pooled by treatment group. All egg, excreta and tissue samples were blended and processed and stored at –20°C until analysis. All samples were analysed by radioanalysis using a liquid scintillation counting system for total radiocarbon content.

The material balance and analysis of extractable residues in liver samples was investigated by Singer and El Naggar (1987, P-1834). Samples of homogenised liver were blended with acetone/hexane (1/1). The extract was subsequently partitioned into acetonitrile and hexane. The acetonitrile extract was further purified by Florisil chromatography. The Florisil fractions obtained were analysed by HPLC, with or without further purification. The hexane soluble lipids were also analysed after an extractive purification and/or saponification. Radioactivity was determined by liquid scintillation counting.

The nature of the unextracted residues in liver was investigated by Wu (1987, P-1840). Samples of homogenised liver were blended with acetone/hexane (1/1). The residual solids were separated by vacuum filtration. The post extraction solids were further processed by methanol blending, soxhlet extraction, acid hydrolysis and protease digestion. Analysis was performed by HPLC and radioactivity was determined by liquid scintillation counting ($^{14}CO_2$ combustion analysis).

Egg, muscle, and abdominal fat samples of the white leghorn hens dosed orally with bifenthrin from the Jameson, Shaffer (1986, PC-0046) study were analysed by Tullman and El Naggar (1987, P-1835). Egg, separated in yolk and white, muscle, and abdominal fat samples had been homogenised and frozen in glass jars. Combustion analysis of samples for total radiocarbon was carried out. Tissues containing less than 0.1 mg/kg, which held true for egg white and pectoral muscle, were not analysed further. Egg yolks from days five and ten were analysed as representative of the overall disposition in egg yolk throughout the ten day period. Samples from each of the matrices were processed and purified by Florisil chromatography. Analysis was performed by HPLC, GPC, or TLC. Radioactivity was determined by liquid scintillation counting. Purified metabolites were subjected to GC/MS analysis. Total residues found in the egg yolk and egg white as well as in excreta and tissues are summarised in Table 8. Values listed are the means of duplicate determinations of pooled samples.

Table 8 ^{14}C-bifenthrin equivalents (mg/kg) in eggs, excreta and tissue (P-1835)

Matrix	Study day	Bifenthrin equivalents (mg/kg)					
		Control		CP label		PH label	
Egg		Yolk	White	Yolk	White	Yolk	White
	-1	< 0.0004	< 0.003	< 0.0004	< 0.003	< 0.0004	< 0.003
	1	< 0.0004	< 0.003	< 0.0004	< 0.003	< 0.0004	< 0.003
	2	< 0.0004	< 0.003	0.09	0.03	0.06	0.01
	3	< 0.0004	< 0.003	1.40	0.03	0.60	0.02
	4	< 0.0004	< 0.003	1.22	0.03	1.26	0.02
	5	< 0.0004	< 0.003	1.64	0.04	1.98	0.02
	6	< 0.0004	< 0.003	2.46	0.04	2.51	0.02
	7	< 0.0004	< 0.003	2.86	0.05	3.18	0.02
	8	< 0.0004	< 0.003	3.18	0.04	3.22	0.02
	9	< 0.0004	< 0.003	3.29	0.04	3.32	0.02
	10	< 0.0004	< 0.003	3.20	0.04	3.28	0.01
Excreta	-2	< 0.011		< 0.018		< 0.011	
	8	< 0.011		32.9		34.0	
	9	< 0.011		44.5		43.1	
	10	< 0.011		55.0		48.2	
Tissue							
Adductor muscle		< 0.006		0.14		0.10	
Pectoral muscle		< 0.006		0.06		0.03	
Liver		< 0.006		1.94		1.37	
Fat		< 0.006		2.09		2.17	

The nature of the residues in muscle, fat, liver, and egg yolk of the Jameson, Shaffer (1986, PC 0046) feeding study was further investigated by a variety of different methods. The results are summarised in Table 9.

Table 9 Residues in poultry orally dosed with CP- and PH-^{14}C bifenthrin (P-1835, P-1834, P-1840).

Fraction	10-day egg yolk [a]		Abdominal fat[a]		Adductor muscle [a]		Liver extracted[2]		Liver non-extracted[3]	
	%	mg/kg	%	mg/kg	%	mg/kg	%	mg/kg	%	mg/kg
CP-^{14}C bifenthrin										
Bifenthrin	43.6	1.44	51.5	1.0	44.2	0.066	2.2	0.05	0.05	< 0.01
4'OH-bifenthrin					5.4	0.008			0.02	< 0.01
Fatty acid conjugates[4] of OH-methyl bifenthrin	33.8	1.12	21.8	0.42	6.9	0.01	24.8	0.54	< 0.01	< 0.01
OH-methyl bifenthrin	4.6	0.15	4.6	0.09	6.3	0.009	12.1	0.27	0.02	< 0.01
TFP acid	0.038	0.001	0.37	$7x10^{-4}$			24.5	0.54	0.13	< 0.01
OH-methyl TFP-acid			0.05	10^{-4}			5.8	0.13	8.6	0.19
OH-methyl TFP-acid Lactone	0.57[5]	0.009					0.9	0.02		
Unidentified[6]	17.9	0.29	21.5	0.41	37.3	0.056				
3',4'-dimethoxy bifen.									0.05	< 0.01
4'-methoxy bifenthrin									0.04	< 0.01
Polar metabolites									6.95	0.15
Non-polar metabolites									2.41	0.05
Semi-solids									1.91	0.04
Bound									3.95	0.09
Others									1.12	0.02
Total	100.5	3.01	99.8	1.92	100	0.15	70.3	1.55	25.3	0.54
PH-^{14}C bifenthrin										
Bifenthrin	38.8	1.38	53.0	1.2	43.9	0.06	4.1	0.05		
4'OH-bifenthrin									0.09	< 0.01
Fatty acid conjugates[4] of OH-methyl bifenthrin	36.4	1.30	19.2	0.42	6.6	0.009	28.9	0.39		
OH-methyl bifenthrin	3.5	0.12	6.8	0.15			18.4	0.25	0.09	< 0.01
BP-alcohol	4.2	0.15	1.8	0.04					2.17	0.03
4'-OH-BP acid	3.9E-3	1.4E-4	7.5E-3	1.7E-4						
4'-OH-BP alcohol	0.012	4.3E-4	7.5E-3	1.7E-4						
OH-methyl-bifenthrin/BP-alcohol					14.3	0.019				
Unidentified[5]	16.9	0.60	20.3	0.45	34.5	0.045				
BP-aldehyde									0.11	< 0.01
3'4'-dimethoxybifen.									0.29	< 0.01
4'-methoxy bifenthrin									0.06	< 0.01
3',4'-dimethoxy-BP acid									8.55	0.12
4'-methoxy BP acid									2.53	0.03
3',4'-dimethoxy-BP alc.									0.79	0.01
4'-methoxy BP alcohol									1.22	0.02
Polar metabolites									5.20	0.07
Bound									6.36	0.09
Others									12.56	0.17
Total	99.8	3.56	101.1	2.26	99.3	0.13	51.4	0.69	40.5	0.54

[a] Tullman, El Naggar 1987

[b] Singer, El Naggar 1987

[c] Wu 1987

[d] Mixture of oleoyl and palmitoyl esters of hydroxymethyl-bifenthrin (FMC 108561)

[e] Five day egg yolk

[f] Several products, no one of which approaches 10% of TRR

The proposed metabolic pathway of bifenthrin in hens is presented in Figure 2.

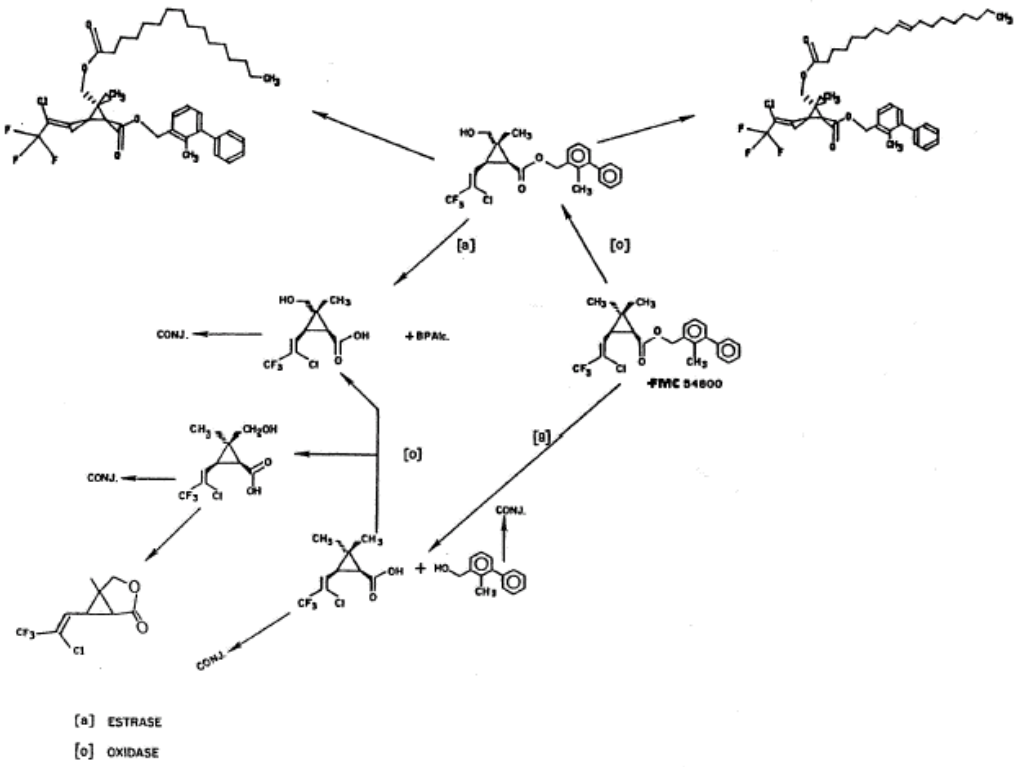


Figure 2 Proposed metabolic pathway of bifenthrin in hens

Plant metabolism

The metabolism of bifenthrin has been studied in apples, cotton, maize and potatoes.

Apple

Apples, field-treated three times (48 g ai/hL) with an PH-^{14}C bifenthrin formulation at approximately three weeks interval, were harvested at 0, 7, 14 and 21 days following last application. Radio-labelled residues were isolated from fruit by acetone extraction followed by hexane/ethyl acetate partition. Analysis was conducted by HPLC, TLC and liquid scintillation counting (Bixler 1983, P-0773). More than 90% of the radioactive residues remained in the peel at all sampling intervals. Radioactivity could be initially removed by a surface rinse with acetonitrile, but the amount declined significantly with increasing sampling times. The total radioactivity in the whole apple declined over the sampling interval, however the later was principally due to growth dilution. HPLC assay of all acetonitrile rinses indicated that parent accounted for 100% of the total radioactive residue in that fraction (Table 10).

At the 21 days interval parent comprised 98% of the TRR, no significant cis- to trans-isomerisation was detected by HPLC assay of the 21 days peel extract. A total of 97.3% of the recovered radioactivity was present in the cis-configuration. This was found not to be different from the starting product, which contained 98.4% cis-isomer. Analysis of the 21-day apple pulp sample showed that 88.7% of the radioactivity was parent, with 5% being polar aqueous products. Table 11 presents the material balance/product distribution for apple peel and pulp. Table 12 presents a comparison of the total radioactive residues in peel and in pulp.

The formulated PH- and CP-^{14}C bifenthrin (12 and 24 g/hL) was pipetted onto apples and leaf surfaces respectively and harvested after 0, 7, 14 and 21 days. After harvest apples were immediately weighed and rinsed with acetonitrile. The peel was removed and re-weighed. The apple peel, pulp and acetonitrile rinses were stored between -20 °C to -70 °C until analysis. The apple leaves were weighed then frozen at -70 °C until analysis. Leaves, field-treated three times with PH-^{14}C bifenthrin and leaves field-treated once with CP-^{14}C bifenthrin, were harvested 28 days following last application. Apple fruit and leaves were subjected to acetone extraction followed by hexane/ethyl acetate partition. Analysis was conducted by HPLC, TLC and liquid scintillation counting.

The distribution of ^{14}C residues in apple fruit are summarised in Table 10 (Bixler 1983, P-0773; 1985, P-1067). The majority of the residues remained in the peel at all intervals. A significant level of radiocarbon could be initially removed by surface (acetonitrile) rinse but the amount declined significantly in subsequent sampling intervals. HPLC and TLC analysis of the acetonitrile surface rinse showed that parent compound accounted for > 98% of the total ^{14}C residues in the fraction.

Table 10 ^{14}C residues and % distribution in apple fruit

Reference	Compound	Matrix	DAT			
			0	7	14	21
P-0773 Bixler 1983	PH-^{14}C bifenthrin	TRR (mg/kg) whole apple	0.81	0.74	0.74	0.71
		% ^{14}C Distribution				
		Acetonitrile rinse	16.2	4.1	2.2	2.0
		Peel	75.0	86.2	91.4	90.8
		Pulp	8.8	9.7	6.4	7.2
		Total	100	100	100	100
P-1067 Bixler 1985	CP-^{14}C bifenthrin	TRR (mg/kg) whole apple	0.72	0.59	0.43	0.59
		% ^{14}C Distribution				
		Acetonitrile rinse	33.7	4.7	3.0	2.0
		Peel	61.7	93.8	83.4	82.5
		Pulp	4.8	1.6	13.6	15.5
		Total	100	100	100	100

The material balance/product distribution of bifenthrin in/on apple peel and pulp is shown in Table 11. At the 21-day interval parent compound comprised 95.5–98.0% of the ^{14}C total residue. No significant cis- to trans-isomerisation was detected by HPLC assay of 21 days peel extract. A total of 95.2–97.3% of the recovered residue was present in the cis-configuration. Analysis of the 21 day pulp showed that 80.3–88.7% of total ^{14}C residue was bifenthrin, with 5.0–10.7% as polar aqueous products and 3.0–7.4% unidentified metabolites, none of which exceeded 3.8%.

Table 11 ^{14}C bifenthrin apple peel and pulp material balance/product distribution in %

Reference	Compound	Matrix	DAT Peel				Pulp
			0	7	14	21	21
P-0773 Bixler 1983	PH-^{14}C bifenthrin	Total organosoluble	98.2	99.2	99.1	99.4	91.7
		bifenthrin	96.0	98.3	98.1	98.0	88.7
		unidentified metabolites	2.2	0.9	1.0	1.4	3.0
		Aqueous polar products	0.1	-	0.3	0.1	5.0
		PES	1.7	0.8	0.6	0.5	3.3
		Total	100	100	100	100	100
P-1067 Bixler 1985	CP-^{14}C bifenthrin	Total organosoluble	99.2	98.2	96.8	97.7	87.7
		bifenthrin	92.7	95.1	95.1	95.5	80.3
		unidentified metabolites	6.5	3.1	1.7	2.2	7.4
		Aqueous polar products	-	-	-	-	10.7
		PES	0.8	1.8	3.2	2.3	1.6
		Total	100	100	100	100	100

Table 12 gives a comparative summary of total ^{14}C residues in peel and pulp with percent of bifenthrin. The majority of the residue remains on the peel rather than in the pulp at all intervals.

Table 12 Percent total ^{14}C residue (TRR) in apple peel and pulp

Reference	Compound	DAT	Peel		Pulp	
			% TRR	% bifenthrin (mg/kg)	% TRR	% bifenthrin (mg/kg)
P-0773 Bixler 1983	PH-^{14}C bifenthrin	0 7 14 21	91.2 90.3 93.7 92.8	88.2 (0.71) 88.8 (0.77) 91.9 (0.59) 91.0 (0.55)	8.8 9.7 6.4 7.2	
P-1067 Bixler 1985	CP-^{14}C bifenthrin	0 7 14 21	95.2 98.4 87.4 84.5	89.7 (0.75) 93.8 (0.55) 82.3 (0.35) 80.7 (0.48)	4.8 1.6 13.7 15.5	NA NA NA 12.4 (0.07)

NA = not analysed

Material balance and product distribution of leaves harvested 28 days after treatment with bifenthrin (Bixler 1985, P-1067) is summarised in Table 13. Parent compound accounted for the main part of total ^{14}C residue in leaves treated with either PH-^{14}C or CP-^{14}C, respectively. None of the unidentified metabolites exceeded 3.9%. The leaf extracts were also analysed for cis- to trans-isomerisation by HPLC. In both cases (PH-^{14}C–79.9%, CP-^{14}C–85%), the majority of ^{14}C residue was present in the cis-configuration.

Table 13 Material balance/product distribution in 28 day apple leaves (P-1067)

Fraction	PH-^{14}C bifenthrin	CP-^{14}C bifenthrin
Total organosoluble	95.0	97.6
bifenthrin	83.9	87.7
biphenyl acid	2.6	NA
unidentified metabolites	8.5	9.9
Aqueous polar products	1.1	0.5
PES	3.9	1.9
Total	100	100

NA = not analysed

Untreated apples, harvested 28 days after last application of bifenthrin to leaves, were analysed for total ^{14}C residue to investigate leaf to fruit translocation. Low (0.015–0.073 mg/kg) but detectable levels of ^{14}C were found on the peel of untreated apples. Because of the low levels no product identification was attempted.

Cotton

Seeds in maturing cotton plants (where the bolls have split open) were treated with PH-^{14}C bifenthrin at a rate of approximately 1.3 µg per seed. Unlabelled bifenthrin was used as a standard for HPLC as well as TLC. Treatment was conducted by trimming the lint in order to expose part of the surface of a seed. Then formulated radiochemical was applied to the exposed area. Seeds were allowed to dry and were covered again by folding the lint back around them. Samples were taken at immediately after the radiochemical had dried, at 14 days and 28 days after treatment. For the time up to 28 days after treatment plants were maintained in a greenhouse. At sampling the lint of each seed was removed and stored separately from the seed. All samples were stored frozen until analysis. For analysis samples were extracted by ultrasonication in acetonitrile. The percent distribution of ^{14}C in post-treatment cotton bolls and the recoveries of ^{14}C based on levels of applied radiochemical are listed in table 14.

Table 14 Percent distribution of ^{14}C post-treatment cotton bolls (P-0759)

Cotton parts	Average of 4 replicates		
	0 DAT	14 DAT	28 DAT
Treated seeds			
AER (acetonitrile extracted residue)	86.4	75.8	80.4
PES	1.4	5.2	7.8
Adjacent lint			
AER	12.0	17.3	9.6

Cotton parts	Average of 4 replicates		
	0 DAT	14 DAT	28 DAT
PES	0.1	0.9	1.2
Remaining lint and seed			
AER	0.2	0.7	1.0
PES	-	-	-
Total AER extracted	98.6	93.8	91.0
Total ^{14}C recovery	92.0	78.3	54.5
Average % ^{14}C bifenthrin recovered	96.5	94.8	91.3

Analysis of the acetonitrile extractable ^{14}C residues indicated that about 90% of recovered radioactivity was unchanged parent compound, indicating that parent compound did not significantly degrade in/on cottonseed (Table 15). Levels of degradation products were found to be minimal, and none of the, up to 6, minor products exceeded 2.1% of the total recovered ^{14}C residue at any interval. Negligible ^{14}C residues were found in various parts of untreated cotton bolls and the plant (not detected in lint, seed, stems, 0.08% in bolls, 0.07% in leaves), suggesting that the parent compound does not translocate from treated cottonseed to untreated parts of the plant. Total recoveries of applied radioactivity showed evidence that a significant portion of ^{14}C was lost via volatilisation.

Table 15 Distribution summary of residue in/on cotton seed (P-0759)

	% Recovered radioactivity		
	0 DAT	14 DAT	28 DAT
Acetonitrile extract	98.7	93.8	91.0
bifenthrin	95.1	88.9	83.1
metabolites	3.5	4.9	7.9
Non-extracted residue	1.5	7.1	9.0
Total	100	100	100

Cotton plants at approximately 3 weeks after planting were treated with PH and CP-^{14}C bifenthrin by applying formulated radiochemical to leaves and soil of separate plants. Unlabelled bifenthrin was used as a standard for HPLC and for TLC as well as for isotopic dilution. Each test plant was grown in a pot maintained on tables in a greenhouse. For leaf-treatment each radiolabelled chemical was applied to top surface of 5–12 leaves per plant. For soil treatment each radiolabelled chemical was applied to soil surface (the rate of application around 2.5 kg/ha). For both treatments untreated control plants were placed side-by-side in order to measure levels of background radioactivity. Plant samples were harvested at 0, 14 and 28 days following treatment as well as at maturity (boll opening). Plants were separated into leaves and stems at immature intervals. At maturity plants were separated into leaves, stems, boll husks, lint and seeds. The material balance product distribution of bifenthrin in/on treated leaves is shown in Table 16.

Table 16 ^{14}C bifenthrin cotton leaf treatment, material balance/product distribution in % (P-1341)

Fraction	DAT							
	0		14		28		Maturity	
	PH-^{14}C	CP-^{14}C	PH-^{14}C	CP-^{14}C	PH-^{14}C	CP-^{14}C	PH-^{14}C	CP-^{14}C
Bifenthrin	96.1	94.7	82.8	87.5	78.7	77.7	62.5	64.6
BP acid	-	-	-	-	-	-	0.2	-
BP alcohol	-	-	-	-	-	-	0.4	-
TFP acid	-	-	-	0.2	-	0.8	-	0.3
Unidentified	3.1	2.2	7.6	5.1	9.3	12.7	11.9	12.0
Total organosoluble	99.2	97.9	90.4	92.8	88.0	91.2	75.0	76.9
Aqueous	0.1	2.3	3.8	4.8	3.4	2.8	7.6	11.5
PES	0.7	0.8	5.8	2.4	8.6	7.0	17.4	11.6
Total	100	100	100	100	100	100	100	100

The majority of the residue was extracted using organic solvents. Total of the extracted ^{14}C decreased with time as levels in post-extraction solids increased. The organic extracts were comprised mostly of parent compound, with greater than 83% of the organo-soluble fractions remaining as

unchanged bifenthrin. Other minor products included BP acid, BP alcohol and TFP acid. The remainder of the organo-soluble fractions consisted of at least six unidentified products with none exceeding 5.1% of total ^{14}C recovered in treated leaves. No cis- to trans-isomerisation of extracts, each analysed at maturity, was observed.

The material balance product distribution of bifenthrin in/on treated soil is shown in Table 17. The majority of the ^{14}C residue remained in the soil. The major product found in soil extracts was unchanged bifenthrin. BP acid, BP alcohol and TFP acid were also detected in low levels. The metabolite present in the highest amount was 4'-OH-bifenthrin. The remaining unidentified products amounted to three, none of that exceeded 1.7% of total ^{14}C recovered.

Table 17 ^{14}C bifenthrin soil treatment, material balance/product distribution (P-1341)

Fraction	DAT 0		14		28		Maturity	
	PH-^{14}C	CP-^{14}C	PH-^{14}C	CP-^{14}C	PH-^{14}C	CP-^{14}C	PH-^{14}C	CP-^{14}C
Bifenthrin	85.3	79.8	70.3	78.4	83.4	84.2	66.8	75.1
BP acid	-	-	-	-	-	-	0.2	-
BP alcohol	-	-	-	-	-	-	0.4	-
TFP acid	-	-	-	-	-	-	-	0.6
4'-OH bifenthrin	-	-	1.2	0.8	2.1	1.2	6.9	4.9
Unidentified	1.6	2.7	2.3	2.7	3.8	4.5	5.7	5.2
Total organosoluble	86.9	82.5	73.8	81.9	89.3	89.9	80.0	85.8
Aqueous	3.0	8.8[a]	16.1[b]	7.4[c]	3.6	3.4	4.0	1.5
PES	10.1	8.7	10.1	10.7	7.1	6.7	16.1	12.7
Total	100	100	100	100	100	100	100	100

[a] 8.8% bifenthrin by HPLC

[b] 16.1% bifenthrin by HPLC

[c] 7.4% bifenthrin by HPLC

The majority of the ^{14}C leaf treatment residue remained at the site of application with low levels being found in untreated parts of the cotton plants. The same holds true for the majority of the ^{14}C soil treatment residue. The majority of ^{14}C remained in the soil. For both ^{14}C labels there was no translocation of bifenthrin to cottonseed from treated soil (Table 18).

Table 18 ^{14}C residues (mg/kg bifenthrin equivalents) in untreated plant parts (P-1341)

Treatment	Fraction	PH-^{14}C bifenthrin DAT				CP-^{14}C bifenthrin DAT			
		0	14	28	Maturity	0	14	28	Maturity
Leaf	Leaves	0.23	0.03	0.02	0.01	0.01	0.002	0.0	0.0
	Stems	0.04	0.02	0.002	0.004	0.0	0.001	0.0	0.004
	Husks	-	-	-	0.014	-	-	-	0.002
	Lint	-	-	-	0.001	-	-	-	LMQ[a]
	Seeds	-	-	-	0.004	-	-	-	LMQ
Soil	Leaves	0.0	1.28	1.27	0.27	LMQ	0.0	0.0	0.44
	Stems	0.0	0.48	0.22	0.30	0.0	0.0	0.0	0.34
	Husks	-	-	-	0.04	-	-	-	0.0
	Lint	-	-	-	LMQ	-	-	-	LMQ
	Seeds	-	-	-	LMQ	-	-	-	LMQ

[a] LMQ = Less than Method Quantification, i.e., dpm in combusted samples less than 1x background of scintillation cocktail

Maize

^{14}C bifenthrin was applied as diluted formulation to leaves and husks of young maize plants. Un-labelled bifenthrin was used as a standard for HPLC and for isotopic dilution. Both labelled and non-labelled bifenthrin used in the study were primarily of the cis-configuration (> 98%). The test

chemical was applied to coat the entire leaf surface. In a separate test the product was applied to soil treated post emergence. The application rates approximated a total of CP 0.53 kg ai/ha and for PH 0.48 kg ai/ha for foliar and for CP 2.27 kg ai/ha and for PH 2.26 kg ai/ha for soil. For each treatment, control plants and soils were treated with a control formulation and placed side-by-side with the treated samples in order to measure levels of background radioactivity.

Plants receiving only leaf treatments were harvested for analysis 0, 7, 14 and 30 days from the last application, while plants, which received both leaf and husk treatments were harvested at maturity only. Finally, plants whose soil was treated with ^{14}C bifenthrin were harvested at silage stage and maturity. All samples were stored at -70 °C until analysis. Total residues in plants were determined by combustion analysis. Radio-labelled residues were extracted from treated leaves by acetone blending and ethyl acetate partition. The polar aqueous and post extraction solids were hydrolysed in 0.25N HCl and then partitioned with ethyl acetate. The analysis was performed by HPLC, TLC and liquid scintillation counting. Total ^{14}C residues in maize grain, plants and leaves are summarised in Table 19.

Table 19 Total ^{14}C residues (bifenthrin equivalents in mg/kg) in maize (P-1498)

Plant part	Method/Timing		CP-^{14}C bifenthrin	PH-^{14}C bifenthrin
Grain	Method of application			
	Leaf	Treat	0.057	0.057
		Control	0.053	0.057
	Leaf and Husk	Treat	0.073	0.079
		Control	0.053	0.057
	Soil	Treat	0.073	0.077
		Control	0.058	0.048
Plants	Harvest interval			
(soil treatment)	Silage (whole plant)			
	Treat		0.07	0.07
	Control		0.21	0.04
	Maturity (stalk/leaves)			
	Treat		0.30	0.15
	Control		0.10	0.25
	Husk			
	Treat		0.07	0.24
	Control		0.17	0.19
Leaves	DAT			
(foliar treatment)	0	Treat	29.51	29.11
		Control	0.12	0.13
	7	Treat	19.89	25.87
		Control	0.17	0.19
	14	Treat	20.78	27.00
		Control	0.24	0.23
	30	Treat	20.48	25.39
		Control	0.22	0.21

The total apparent ^{14}C residue in maize grain was of the order of approximately 0.07 mg/kg from all the three treatments and was not significantly different from that in the controls. After soil treatment some values (stalk/leaves of the CP label, husks of the PH label) suggested some uptake from the soil. However in half of the six possible comparisons, values of the control exceeded those of the treated samples. The ^{14}C residues in maize plant leaves declined slowly from approximately 30 mg/kg on the day of last application to approximately 20–25 mg/kg after 30 days with both labels.

The majority of the residue was directly extractable using organic solvents (Table 20). Over the course of the study the amount of residue extracted decreased as the amount in the aqueous and PES fraction increased. The major product found was parent compound and 4'-OH-bifenthrin was the only relevant metabolite. None of the 5-7 unidentified metabolites exceeded 2.7% of the total ^{14}C residue. There was no cis- to trans-isomerisation in that the percentage of trans-isomer remained relatively constant over all harvesting intervals. Post-extraction solids accounted for about 9% of the total recovered radioactivity.

Although no compounds were identified owing to the low levels, analysis after HCl hydrolysis of the 30 days PES fraction revealed approximately 2% of the total recovered radioactivity to be due to the PES organosoluble fraction and about 0.7-1% to the aqueous fraction, with about 7% bound.

Table 20 ^{14}C bifenthrin leaf treatment material balance/product distribution in % (P-1498)

Fraction	CP-^{14}C bifenthrin DAT				PH-^{14}C bifenthrin DAT			
	0	7	14	30	0	7	14	30
Non-polar								
Cis-bifenthrin	86.5	74.9	72.9	65.5	83.2	74.3	74.2	64.8
Trans-bifenthrin	0.4	0.4	0.4	-	1.6	1.1	1.1	1.1
4'-OH-bifenthrin	6.0	7.9	10.0	11.8	6.2	8.3	11.1	8.8
BP-acid	-	-	-	-	-	0.4	0.7	0.4
BP-alcohol	-	-	-	-	0.3	-	-	0.4
BP-aldehyde	-	-	-	-	0.2	0.3	0.4	0.5
Unidentified	2.3	2.9	3.3	5.2	2.6	3.5	4.3	6.3
Total	95.2	86.1	86.6	82.5	94.1	87.9	91.8	82.3
Aqueous								
Cis-bifenthrin	2.0	3.2	3.1	2.2	2.6	3.6	0.3	1.1
Trans-bifenthrin	0.1	0.1	0.1	-	0.1	0.1	-	-
4'-OH-bifenthrin	0.2	0.4	0.5	0.5	0.2	0.4	0.1	0.3
BP-acid	-	-	-	-	0.1	0.1	0.1	0.2
BP-alcohol	-	-	-	-	0.1	0.2	0.3	0.7
BP-aldehyde	-	-	-	-	0.1	0.1	0.1	0.1
TFP acid	0.2	0.2	0.2	0.9	-	-	-	-
Unidentified	0.9	0.8	1.2	4.1	1.0	2.1	2.4	4.9
Total organosoluble	3.4	4.7	5.1	7.7	4.2	6.6	3.3	7.3
Polar aqueous	0.2	0.2	0.3	0.8	0.2	0.5	0.7	1.0
Total	3.7	4.9	5.4	8.5	4.4	7.1	3.9	8.3
PES								
Organosoluble	NA	NA	NA	1.8	NA	NA	NA	1.6
Polar aqueous	NA	NA	NA	0.6	NA	NA	NA	1.0
Bound	NA	NA	NA	6.6	NA	NA	NA	6.8
Total	1.2	9.0	8.0	9.0	1.5	5.0	4.3	9.4

NA = not analysed

The metabolism of bifenthrin in/on maize was studied using ^{14}C bifenthrin labelled uniformly in the phenyl ring position to determine the nature and magnitude of the residues (Liu and Wang 2007, PC-0370). Bifenthrin was applied in/on greenhouse grown maize by a single foliar application in a simulated EC formulation at the rate of 0.56 kg ai/ha at the ~50% flowering stage. Maize forage was harvested 29 days after application. The mature plant and cobs (grain and stover) was harvested at 77 days after the application (48 days after the harvest of forage). All samples were processed within 3 days of collection.

Samples from treated plants were extracted with ACN and/or MeOH, and/or ACN or MeOH/H_2O mixture. Analyses were made by liquid scintillation counting, reversed-phase HPLC, and normal-phase TLC with auto-radiographic technique. Cis- and trans-bifenthrin, 4' hydroxy bifenthrin, biphenyl alcohol, and biphenyl acid were used as the reference standards. A summary of results is shown in Table 21.

Table 21 Distribution of bifenthrin and metabolites in maize forage and stover (PC-0370)

Component	Forage (29 DAT)		Stover (79 DAT)	
	% TRR	mg/kg	% TRR	mg/kg
Extracted	94.51	1.11	88.34	6.18
cis-bifenthrin	66.92	0.78	63.57	4.45
trans-bifenthrin [a]	3.57	0.042	4.27	0.30
4'OH bifenthrin	10.89	0.13	8.28	0.58
BP-alcohol	ND	ND	ND	ND
BP-acid	ND	ND	ND	ND

Component	Forage (29 DAT)		Stover (79 DAT)	
	% TRR	mg/kg	% TRR	mg/kg
Unidentified [b]	13.13	0.15	12.2	0.86
PES	5.50	0.065	11.66	0.82

ND = Not detected

[a] The trans-bifenthrin may result from the dosing solution and or phototransformation.

[b] Forage contains 3–5 products. No individual component > 6.2% of TRR.

Stover contains 3–11 products. No individual component > 3.1% of TRR.

Bifenthrin does not translocate to any significant degree from the site of application to maize grain as a result of foliar application. Similar results were reported in the study P-1498 by Bixler and Gross (1987) for the soil, leaf, and/or husk treatments. Foliar application of bifenthrin resulted in a gradual breakdown of parent chemical by hydroxylation, with the major metabolite being 4'-hydroxy bifenthrin.

Potatoes

The metabolism of bifenthrin in potato was studied using ^{14}C bifenthrin labelled at the 1-position of the cyclopropyl ring or uniformly in the phenyl ring positions to determine the nature and magnitude of its residues (Schwartz and Heitkamp 2001, PC-0313). Bifenthrin was applied to soil in-furrow at planting and twice foliar to greenhouse-grown potatoes. The application regimen was designed to simulate a field-like application where the soil was treated at the rate of ~0.34 kg ai/ha at the time of planting followed by two foliar applications each at ~0.11 kg ai/ha, at 28 and 14 days pre-harvest interval for a total of 0.56 kg ai/ha. In addition, soil was treated by in-furrow application at a 5X application rate with each label separately. The mature harvest was sampled 14 days after the last application. The TRR was determined by combustion analysis followed by LSC. The results are summarised in Table 22.

Table 22 Distribution of TRR in potatoes of mature harvest (PC-0313)

Label	Fraction	Tuber		Foliage	
		% TRR	TRR (mg/kg)	% TRR	TRR (mg/kg)
CP-^{14}C	Starting TRR	100	0.047	100	2.70
	Hexane	74.4	0.035	94.5	2.55
	Ether/ACN	14.2	0.007	NA	NA
	Aqueous	3.89	0.002	1.2	0.03
	PES	7.51	0.004	4.27	0.12
PH-^{14}C	Starting TRR	100	0.038	100	1.94
	Hexane	87.3	0.033	95.7	1.85
	Ether/ACN	1.91	0.001	NA	NA
	Aqueous	2.17	0.001	0	0
	PES	8.62	0.003	4.29	0.08

The non-polar and polar extracted components (hexane and ether extracts, respectively) were analysed using HPLC. The metabolites were tentatively characterised by retention time comparison with the reference standards. Parent was identified by co-chromatographic analysis and confirmed by TLC as a second method. The results are shown in Table 23.

Table 23 Identified and/or characterised bifenthrin and metabolites from the tuber (PC-0313)

Compound in the tuber	CP label (0.047 mg/kg)		PH label (0.038 mg/kg)	
	% TRR	mg/kg	%TRR	mg/kg
Bifenthrin	73.3	0.034	81.1	0.031
4'-OH-Bifenthrin	1.20	0.0006	0.10	0.00003
TFP acid	0.93	0.0004	NA	NA
Biphenyl alcohol and/or acid	NA	NA	0.09	0.00003
Biphenyl aldehyde	NA	NA	0.07	0.00003
Polar	7.62	0.004	0.55	0.00021

NA = Not applicable

The proposed metabolic pathway of bifenthrin in plants is presented in Figure 3.

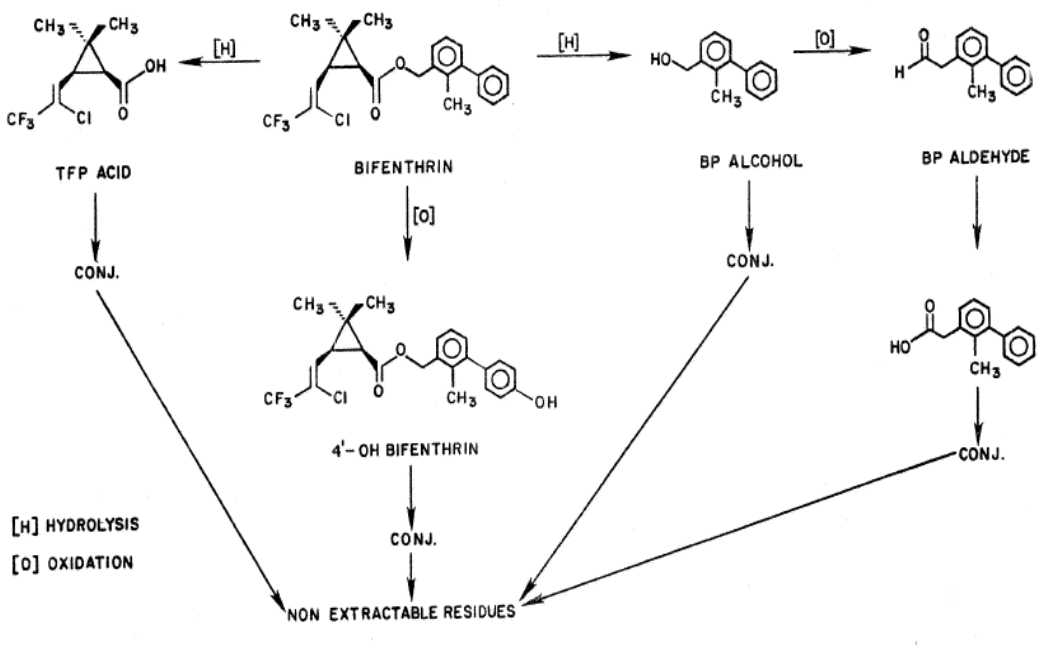


Figure 3 Proposed metabolic pathway of bifenthrin in/on plants.

Environmental fate in soil

The FAO Manual (FAO, 2009) explained the data requirements for studies of environmental fate. The focus should be on those aspects that are most relevant to MRL setting. For bifenthrin, supervised residue trials data are available for root and tuber vegetables, which mean that aerobic degradation in soil is relevant, as well as the normal requirements for hydrolysis, soil photolysis and rotational crop studies. The Meeting received information on soil aerobic metabolism, soil photolysis, hydrolysis and confined crop rotation properties of bifenthrin.

Soil metabolism, soil photolysis and hydrolysis

Details of soil aerobic metabolism, soil photolysis and hydrolysis studies are summarised below.

Aerobic soil metabolism Ref: Reynolds 1984, P-1009

Test material: PH-^{14}C bifenthrin Dose rate: 1 mg ai/kg

Duration: 21 days Temp: 25 °C Field moisture capacity: 65%

Soil: sandy loam pH: 7 Organic matter: 3%

Half-life (parent): - ^{14}C recovery: 95.4-99.8% (day 0)

% bifenthrin remaining, day 21 = 86.9% of dose % mineralisation, day 21 = 3.8% of dose

Aerobic soil metabolism Ref: Reynolds 1984, P-0872; Reynolds 1986, P-1339

Test material: CP-^{14}C bifenthrin Dose rate: 3 mg ai/kg

Duration: 180 days Temp: 25 °C Field moisture capacity: 65%

Soil: silty clay loam pH: 7.5 Organic matter: 2.3%

Half-life (parent): 125 ^{14}C recovery: 89-100% (day 0)

% bifenthrin remaining, day 180 = 34.7% of dose % mineralisation, day 180 = 36.9% of dose

Compounds in organo-soluble fraction	%	Day
Bifenthrin	34.7	180
TFP acid	3.7	
4'-OH-bifenthrin	1.0	
Unidentified	1.6 (none of the metabolites > 0.3% of TRR)	

Aerobic soil metabolism Ref: Reynolds 1984, P-0872; Reynolds 1986, P-1339

Test material: CP-^{14}C bifenthrin Dose rate: 3 mg ai/kg

Duration: 180 days Temp: 25 °C Field moisture capacity: 65%

Soil: sandy loam pH: 7 Organic matter: 3%

Half-life (parent): 50 ^{14}C recovery: 87-98% (day 0)

% bifenthrin remaining, day 180 = 33.0% of dose % mineralisation, day 180 = 35.0% of dose

Compounds in organo-soluble fraction	%	Day
Bifenthrin	33.0	180
TFP acid	0.2	
4'-OH-bifenthrin	5.0	
Unidentified	2.5 (none of the metabolites > 0.3% of TRR)	

Aerobic soil metabolism Ref: Reynolds 1984, P-0872; Reynolds 1986, P-1339

Test material: CP-^{14}C bifenthrin Dose rate: 3 mg ai/kg

Duration: 180 days Temp: 25 °C Field moisture capacity: 65%

Soil: silt loam pH: 7.1 Organic matter: 3.1%

Half-life (parent): 205 ^{14}C recovery: 90-101% (day 0)

% bifenthrin remaining, day 180 = 54.8% of dose % mineralisation, day 180 = 13.4% of dose

Compounds in organo-soluble fraction	%	Day
Bifenthrin	54.8	180
TFP acid	1.6	
4'-OH-bifenthrin	3.7	
Unidentified	2.3 (none of the metabolites > 0.3% of TRR)	

Aerobic soil metabolism Ref: Reynolds 1986, P-1343; Bixler 1983, P-0712; Bixler 1984, P-0800

Test material: PH-^{14}C bifenthrin Dose rate: 1 mg ai/kg

Duration: 120 days Temp: 25 °C Field moisture capacity: 65%

Soil: silty clay loam pH: 7.5 Organic matter: 2.3%

Half-life (parent): 69 days ^{14}C recovery: 94.2-99.3% (day 0)

% bifenthrin remaining, day 120 = 37.7% of dose % mineralisation, day 120 = 28.8% of dose

Compounds in organo-soluble fraction	%	Day
Bifenthrin	39.8	120
Biphenyl acid	0.6	
Biphenyl alcohol	0.2	
Biphenyl aldehyde	0.2	
4'-OH-bifenthrin	3.3	
Unidentified	1.6 (none of the metabolites > 0.8% of TRR)	

Aerobic soil metabolism Ref: Reynolds 1986, P-1343; Bixler 1983, P-0712; Bixler 1984, P-0800

Test material: PH-^{14}C bifenthrin Dose rate: 1 mg ai/kg

Duration: 120 days Temp: 25 °C Field moisture capacity: 65%

Soil: silt loam pH: 7.1 Organic matter: 3.1%

Half-life (parent): 135 days ^{14}C recovery: 90.6%-101.5% (day 0)

% bifenthrin remaining, day 120 = 54.8% of dose % mineralisation, day 120 = 15.6% of dose

Compounds in organo-soluble fraction	%	Day
Bifenthrin	59.0	120
Biphenyl acid	1.7	
Biphenyl alcohol	0.4	
Biphenyl aldehyde	not detected	
4'-OH-bifenthrin	4.1	
Unidentified	5.1 (none of the metabolites> 0.8% of TRR)	

Aerobic soil metabolism Ref: Reynolds 1986, P-1343; Bixler 1983, P-0712; Bixler 1984, P-0800

Test material: PH-^{14}C bifenthrin Dose rate: 1 mg ai/kg

Duration: 120 days Temp: 25 °C Field moisture capacity: 65%

Soil: sandy loam pH: 7.0 Organic matter: 3.0%

Half-life (parent): 87 days ^{14}C recovery: 94.1-98.6% (day 0)

% bifenthrin remaining, day 120 = 43.9% of dose % mineralisation, day 120 = 22.1% of dose

Compounds in organo-soluble fraction	%	Day
Bifenthrin	47.7	120
Biphenyl acid	0.5	
Biphenyl alcohol	0.4	
Biphenyl aldehyde	not detected	

4'-OH-bifenthrin	8.2
Unidentified	3.0 (none of the metabolites > 0.8% of TRR)

Aerobic soil metabolism Ref: Smith 1991, P-1978

Test material: CP-^{14}C bifenthrin Dose rate: 3 mg ai/kg

Duration: 126 days Temp: 25 °C Field moisture capacity: 58.9%, adjusted to 65%

Soil: silt loam pH: 6.5 Organic matter: 4.3%

Half-life (parent): 75 days ^{14}C recovery: 93–102% (day 0)

% bifenthrin remaining, day 126 = 28.3% of dose mineralisation, day 126 = 49.7% of dose

Compounds in organo-soluble fraction	%	Day
Bifenthrin	31	126
4'-OH-bifenthrin	3.8	30
4'-OH-bifenthrin	2.5	126
TFP acid	0.8	62
TFP acid	0.5	126

Aerobic soil metabolism Ref: Smith 1991, P-1978

Test material: PH-^{14}C bifenthrin Dose rate: 3 mg ai/kg

Duration: 126 days Temp: 25 °C Field moisture capacity: 58.9%, adjusted to 65%

Soil: silt loam pH: 6.5 Organic matter: 4.3%

Half-life (parent): 93 days ^{14}C recovery: 97–106% (day 0)

% bifenthrin remaining, day 126 = 37.3% of dose mineralisation, day 126 = 36.2% of dose

Compounds in organo-soluble fraction	%	Day
Bifenthrin	39.9	126
4'-OH-bifenthrin	3.6	30
4'-OH-bifenthrin	2.4	126
BP acid	0.7	126
BP alcohol	0.4	62
BP alcohol	0.2	126

Soil surface photolysis Ref: Wu 1986, P-1351

Test material: PH-^{14}C bifenthrin Dose rate: eqiv to 112 g ai/ha

Duration: 30 days Temp: 18–33 °C Moisture: 58.9%, adjusted to 65%

Soil: silt loam pH: 4.8 Organic matter: 2.1%

Light source: natural sunlight

Half-life (parent): 83.5 days ^{14}C recovery: 100% (day 0)

% bifenthrin remaining, day 30 = 79.1%

Compounds in organo-soluble fraction	%	Day
cis-bifenthrin	77.8	21
trans-bifenthrin	2.3	
Biphenyl acid	1.3	
Biphenyl alcohol	1.4	
Biphenyl aldehyde	1.2	
4'-OH-bifenthrin	0.4	

Soil surface photolysis Ref: Wu 1986, P-1351

Test material: CP-^{14}C bifenthrin Dose rate: eqiv to 112 g ai/ha

Duration: 30 days Temp: 18–33 °C Moisture: 58.9%, adjusted to 65%

Soil: silt loam pH: 4.8 Organic matter: 2.1%

Light source: natural sunlight

Half-life (parent): 123.5 days ^{14}C recovery: 100.1% (day 0)

% bifenthrin remaining, day 30 = 82.7%

Compounds in organo-soluble fraction	%	Day
cis-bifenthrin	86.7	21
trans-bifenthrin	1.8	
TFP acid	3.1	
4'-OH-bifenthrin	0.4	

Hydrolysis Ref: Herbst 1983, P-0701

Test material: bifenthrin Dose rate: 0.5 and 5.2 mg/L

Duration: 22 days Temp: 25 °C

Light source: Darkness pH: 5.05, 7.08, 8.97

HPLC analysis: There was no hydrolysis of bifenthrin at none of the pH tested. This was attributed to the highly insoluble nature of bifenthrin in water.

The degradation of bifenthrin in/on soil surface, when exposed to natural sunlight is slow with an average DT_{50} of 103.5 days. No major metabolite were formed; TFP acid reflecting the most predominant identifiable minor metabolite peaking at 3.8% on day 30. Cis/trans isomerisation and ester bond cleavage were the two significant photo-degradation pathways, but with a rather slow degradation rate. Losses due to volatility and thermal decomposition, as well as microbial degradation, were negligible under the described conditions.

Aerobic soil laboratory studies in the laboratory showed DT_{50} values ranging from 50 to 205 days, depending on soil type and ^{14}C label used. Degradation of bifenthrin was more rapid in a sandy loam soil (mean DT_{50} of 78.7 days) than in a silty clay loam (DT_{50} of 97 days) or silt loam soil (DT_{50} of 170 days).

Confined crop rotation

Soil was spiked with CP- and PH-^{14}C radiolabelled bifenthrin at a rate of 0.56 kg ai/ha (Bixler 1986, P-1372). Lettuce, sugar beet, and wheat representative for leafy vegetables, root vegetables, and cereals, respectively, were planted 30, 60, and 120 days following chemical treatment of the soil. Soil samples were taken after 0, 30, 60, and 120 days. When the crops were harvested, soil cores were taken off the top layer of 0–7.62 cm and the upper layer of 7.62–38.1 cm each. Radioactivity in each sample was determined by combustion analysis.

For chromatography, soil samples were extracted with acetonitrile/water. After addition of sodium chloride to the aqueous concentrate, partitioning with ethyl acetate followed, yielding an organo-soluble fraction [I] containing non-polar products, and a polar aqueous fraction [II].

Samples of wheat straw were extracted with water/acetone. After removing the acetone, sodium chloride was added, followed by partitioning with dichloromethane and with ethyl acetate, yielding an organo-soluble fraction containing non-polar products and a polar aqueous fraction. To the polar aqueous fraction, hydrochloric acid was added and the solid residues from the liquid-liquid-partitioning. After refluxing for one hour, the hydrolysates were partitioned with ethyl acetate, yielding an aglycone fraction and a polar aqueous fraction.

Subsequent analyses were by HPLC, TLC, and liquid scintillation counting. Soil samples were analysed for ^{14}C residues at each sowing interval, and upon harvesting of the mature rotational crops (Table 24). The majority of bifenthrin remained in the top soil layer at all sampling intervals.

Table 24 Soil core analysis for total ^{14}C residues (P-1372)

Sample	Sowing interval 30 days		Sowing interval 60 days		Sowing interval 120 days	
	TRR (mg/kg)	DAT	TRR (mg/kg)	DAT	TRR (mg/kg)	DAT
CP-^{14}C bifenthrin						
Sowing (0-7.6 cm)	1.08	30	1.43	60	0.72	120
Mature lettuce		65		103		158
0–7.6 cm	0.90		0.69		0.59	
7.7–38 cm	0.08		0.25		0.10	
Mature sugar beet		145		223		292
0–7.6 cm	0.81		0.77		0.52	
7.7–38 cm	0.08		0.05		0.15	
Mature wheat		126		181		287
0–7.6 cm	0.42		0.51		0.42	
7.7–38 cm	0.11		0.08		0.06	
PH-^{14}C bifenthrin						
Sowing (0-7.6 cm)	0.34	30	1.20	60	0.43	120
Mature lettuce		58		97		153
0–7.6 cm	1.33		0.59		0.43	
7.7–38 cm	0.07		0.08		0.05	
Mature sugar beet		154		224		288
0–7.6 cm	0.53		0.36		1.18	
7.7–38 cm	0.07		0.03		0.10	
Mature wheat		126		182		234
0–7.6 cm	0.28		0.78		0.60	
7.7–38 cm	0.08		0.07		0.04	

The material balance and identification of the soil metabolites in the top soil layer (0–7.6 cm) are summarised in Tables 25 and 26. Levels of organo-soluble ^{14}C residues from both CP-^{14}C and PH-^{14}C treatment decreased from 98.9–38.9%, and from 97.1–42.9%, as the levels of post extraction solids (PES) increased. At the last sampling intervals (the harvest of mature sugar beets), 57.3% and 55.4% of the total ^{14}C residue was bound to the soil matrix. Polar aqueous products remained at levels of 0.1–5.5% during the study.

Table 25 CP-^{14}C-bifenthrin in soil core material balance/product distribution in % (P-1372)

Soil sampling	Organo-soluble ^{14}C residues					Polar aqueous	PES
	Bifenthrin	4´-OH-bifen.	TFP acid	unidentified	Total		
Sowing intervals							
0 day	96.4	-	-	2.5	98.9	0.3	0.8
30 days	85.0	2.3	1.4	5.8	94.9	0.2	5.3
60 days	80.3	4.1	0.9	6.9	92.2	0.3	7.5
120 days	55.5	5.8	5.2	11.7	78.2	1.1	20.7
30 day replant							
lettuce	67.8	7.8	2.2	8.3	86.1	2.4	11.5
sugar beet	59.3	5.0	0.8	5.9	71.0	5.1	23.9
wheat	26.7	9.1	3.1	10.4	49.3	2.6	48.1
60 day replant							
lettuce	41.6	14.1	9.8	9.6	75.1	1.9	23.0
sugar beet	37.2	5.7	2.3	9.4	54.6	5.7	39.7
wheat	40.8	11.6	1.5	11.1	65.0	2.8	32.2
120 day replant							
lettuce	35.7	8.9	9.0	15.7	69.3	5.0	25.7
sugar beet	19.5	4.6	1.6	13.2	38.9	3.8	57.3
wheat	67.5	2.2	1.2	9.4	80.3	0.4	19.3

Table 26 PH-^{14} C-bifenthrin in soil core material balance/product distribution in % (P-1372)

Soil sampling	Organo-soluble ^{14}C residues						Polar aqueous	PES
	Bifenthrin	4´-OH-bifen.	BP acid	BP alcohol	unidentified	Total		
Sowing intervals								
0 day	95.3	-	-	-	1.8	97.1	0.1	2.8
30 days	80.4	2.2	2.0	0.4	3.2	88.2	0.8	10.9
60 days	77.7	3.9	0.9	0.4	4.9	87.8	0.8	11.4
120 days	46.9	9.4	6.8	1.2	7.0	71.3	1.1	27.6
30 day replant								
lettuce	77.8	6.9	0.9	0.6	4.0	90.2	0.4	9.4
sugar beet	40.4	5.4	0.3	0.5	7.2	53.8	0.1	45.3
wheat	38.1	3.4	0.9	0.9	12.5	55.8	5.5	38.7
60 day replant								
lettuce	76.5	5.0	0.4	0.7	4.6	87.2	0.3	12.5
sugar beet	36.9	4.7	0.6	0.7	6.7	49.6	1.8	48.6
wheat	48.7	5.8	0.6	0.9	6.7	62.7	1.0	36.3
120 day replant								
lettuce	28.1	10.9	1.6	1.4	8.4	50.4	1.3	48.3
sugar beet	30.9	3.6	1.1	0.6	6.7	42.9	1.7	55.4
wheat	32.9	5.6	1.5	0.9	8.1	49	0.9	50.1

Residues in rotational crops are summarised in Table 27. TRR ranged from 0.009–0.029 mg/kg in lettuce, 0.014–0.065 mg/kg in sugar beets (whole plant) and 0.012–0.053 mg/kg in wheat (whole plant). At the maturity of lettuce, the residue levels were in the range of 0.012–0.029 mg/kg. Low levels of total residues in the magnitude of 0.005–0.021 mg/kg and 0.004–0.031 mg/kg were found in beet and foliage, respectively. Also in the grains of wheat, 0.016–0.049 mg/kg were determined. Only in wheat straw, higher residues were detected (0.16–0.312 mg/kg).

Table 27 Total ^{14}C-residues in rotational crops at 30 day sowing interval (P-1372)

Crop	Sampling	Total ^{14}C residues (mg/kg)	
		CP label	PH label
30 days sowing interval			
Lettuce	1st thinning	0.019	0.016
	2nd thinning	-	-
	maturity	0.014	0.012
Sugar beet	1st thinning	0.024	0.036
	2nd thinning	0.023	0.014
foliage	maturity	0.031	0.009

Crop	Sampling	Total ^{14}C residues (mg/kg)	
		CP label	PH label
beet		0.021	0.009
Wheat	1st thinning	0.032	0.012
	2nd thinning	0.033	0.014
grain	maturity	0.035	0.016
straw		0.247	0.094
60 days sowing interval			
Lettuce	1st thinning	0.021	-
	2nd thinning	0.026	0.027
	maturity	0.029	0.021
Sugar beet	1st thinning	0.058	0.065
	2nd thinning	0.035	0.021
foliage	maturity	0.023	0.007
beet		0.019	0.008
Wheat	1st thinning	0.032	0.019
	2nd thinning	0.020	0.021
grain	maturity	0.042	0.025
straw		0.247	0.160
120 days sowing interval			
Lettuce	1st thinning	0.019	0.026
	2nd thinning	0.009	0.010
	maturity	0.017	0.014
Sugar beet	1st thinning	0.052	0.049
	2nd thinning	0.027	0.021
foliage	maturity	0.017	0.004
beet		0.008	0.005
Wheat	1st thinning	0.039	-
	2nd thinning	0.053	0.021
grain	maturity	0.049	0.032
straw		0.312	0.193

For the identification of metabolites, wheat straw was analysed by HPLC. The material balance and occurrence of metabolites in wheat straw are summarised in Tables 28 and 29.

Table 28 Material balance of ^{14}C in wheat straw in % of TRR (P-1372)

Fraction	30 days		60 days		120 days	
	CP-^{14}C	PH-^{14}C	CP-^{14}C	PH-^{14}C	CP-^{14}C	PH-^{14}C
Non-polar	28.3	21.8	26.9	28.7	51.0	18.4
Aglycones	42.8	26.4	44.6	11.2	24.5	18.6
Polar aqueous	8.5	12.2	10.3	13.5	9.3	15.3
Bound	20.5	39.7	18.1	46.5	15.3	47.7
Total	100.1	100.1	99.9	99.9	100	100

Table 29 Product distribution in non-polar organo-soluble fraction from wheat straw (P-1372)

Fraction	30 days		60 days		120 days	
	% TRR	mg/kg	% TRR	mg/kg	% TRR	mg/kg
CP-^{14}C label						
Bifenthrin	2.9	0.007	7.0	0.017	7.4	0.023
TFP acid	4.6	0.011	6.7	0.017	2.9	0.009
4´-OH-bifenthrin	0.5	0.001	1.4	0.004	1.4	0.004
Unidentified	20.3	0.050	11.8	0.029	39.3	0.123
Total	28.3	0.070	26.9	0.066	51.0	0.159
PH-^{14}C label						
Bifenthrin	7.5	0.007	10.7	0.017	5.3	0.010
BP acid	1.5	0.002	1.6	0.003	2.2	0.004
BP alcohol	1.2	0.001	1.3	0.002	0.8	0.001
BP aldehyde	0.6	0.001	0.8	0.001	0.3	0.001
4´-OH-bifenthrin	1.3	0.001	2.9	0.005	1.2	0.002
Unidentified	9.7	0.009	11.4	0.018	8.6	0.017

Fraction	30 days		60 days		120 days	
	% TRR	mg/kg	% TRR	mg/kg	% TRR	mg/kg
Total	21.8	0.021	28.7	0.046	18.4	0.035

In a study by Singer (1991, P-2605) soil was treated with CP-^{14}Cand PH-^{14}C radiolabelled bifenthrin at a rate of 0.56 kg ai/ha. Wheat was sowed 30 days, 120 days, 7 months, and 12 months following application to the soil. Soil samples in a depth of 0–15.24 cm were taken at pre treatment, 2 hours post-treatment and at all sowing and harvest times. Plants were harvested at an immature stage, to represent wheat forage, and at maturity. Mature wheat was divided into grain and straw. All samples were stored frozen. TRR in all samples were determined by combustion analysis.

The residues in soil were extracted with acetonitrile/water (70/30) in a blender, with vacuum filtration following each extraction. PES were further extracted by heating at reflux for 1 h with acetonitrile/water (70/30). The filtrate from the reflux was combined with the other filtrates and then partitioned with dichloromethane. The dichloromethane phase was then dried and concentrated for further analysis. Samples of plants were extracted with acetonitrile/water (70/30). The extracts were then filtered. The straw samples were analysed using dichloromethane partitioning. All forage and control samples were extracted by the ethyl acetate partitioning.

In order to characterise the organo-soluble components, a base partitioning was carried out with the ethyl acetate and dichloromethane phases. To validate the presence of TFP and BP acids and to further characterise acidic unknowns, samples were derivatised with p-Br-phenacyl-bromide to give products of known HPLC retention times. The derivates of TFP acid were characterised by MS and 1 H NMR. Bifenthrin and BP alcohol were confirmed by GC-MS in plant samples. PES samples from the 120 day PH label, CP label and control wheat straw samples were fractionated with enzymes and other specific reagents. Further analysis was performed by LSC, HPLC, MS and NMR spectroscopy.

Soil cores were analysed for TRR and for metabolite profile. The residue levels were between 0.264 mg/kg at the planting time of 30 days, and 0.128 mg/kg at 12 months after planting. Bifenthrin was always the major component found in the soil cores. Other components included TFP acid, 4´-OH bifenthrin and BP alcohol and BP acid. Plant materials from all time points were analysed for TRR and metabolite profile. The results of the averages of the three replicate samples analysed are given in Tables 30 and 31.

Table 30 PH-^{14}C-residues in wheat forage and straw (P-2605)

Sowing	TRR (mg/kg)			Bifenthrin	BP alcohol
	Matrix	Control	Net [a]		
Forage					
30 days [b]	0.203	0.011	0.192	ND	-
120 days	0.062	0.008	0.054	0.017	0.006
7 months	0.071	0.030	0.041	0.001	0.005
12 months	0.020	0.005	0.015	ND	-
Straw					
30 days [b]	0.328	0.002	0.326	0.117	0.016
120 days	0.410	0.310	0.100	0.022	0.005
7 months	0.192	0.146	0.046	0.018	0.010
12 months	0.090	0.013	0.077	0.007	0.026

[a] forage/straw residues

[b] 30 days harvest were poor due to insect predation; values given may not reflect those expected in a normal crop.

control = net value

ND = not detected

Table 31 CP-^{14}C-residues in wheat forage and straw (P-2605)

Sowing	TRR (mg/kg) Matrix	Control	Net [a]	Bifenthrin	TFP acid
Forage					
30 days [b]	0.294	0.011	0.283	ND	
120 days	0.124	0.008	0.116	0.041	0.021
7 months	0.119	0.030	0.089	0.000	0.021
12 months	0.044	0.005	0.039	0.002	0.006
Straw					
30 days [b]	0.373	0.002	0.371	0.064	0.028
120 days	0.645	0.310	0.335	0.022	0.032
7 months	0.296	0.145	0.151	0.010	0.026
12 months	0.188	0.013	0.175	0.005	0.027

[a] forage/straw residues

[b] 30 days harvest were poor due to insect predation; values given may not reflect those expected in a normal crop.

control = net value

ND = not detected

Significant levels of radioactivity were observed in control straw from the 120 day and 7 month sowing. Therefore, control levels were subtracted from total levels in the forage and straw samples grown on treated soil. Bifenthrin was present in the 30 day straw at 0.064–0.12 mg/kg. The 120 day straw samples had a level of 0.022 mg/kg bifenthrin, and even lower values were found in samples of the 7 month and 12 month plantings. Organo-soluble material was characterised as being composed of acidic and phenolic components, some of which were derivatable carboxylic acids. TFP acid was identified as one of the derivatised products. The underivatable polar acidic materials may well represent incorporation into natural products, as they were also found in control plants.

Field Crop Rotation

Studies to determine the magnitude of bifenthrin residues in/on wheat grown in rotation following bifenthrin treated crops were undertaken by Culligan (2001, P-3477). Cotton and maize were treated with multiple applications of Capture 2 EC at 0.11 kg ai/ha each for a total of 0.56 kg ai/ha. Wheat forage, hay, straw, and grain was analysed. Seven trials were established in the Midwestern United Sates (OK, AR, KS, OH, NE, IL, WI) during the 1999 growing season. For trials 01 and 02, cotton was the primary crop. For trials 03, 04 and 05, maize was the primary crop. For trials 06 and 07, sweet corn was the primary crop. The applications were broadcast foliar sprays. The first application was made at about 13-19 days prior to normal harvest. The targeted spray interval was 3 days. However, up to 5 days between applications was acceptable if weather prevented the shorter interval. The last application was made 1 or 7 days prior to normal harvest of the primary crop. No samples were collected from the primary crop for each trial.

For all trials, the primary crop was allowed to grow to maturity and harvested. For trials 01 and 02, the cotton was defoliated and harvested according to normal agricultural practice. The plant residue was left on the field and incorporated into the soil. For trials 03 through 07, the primary maize crop was removed from the plot and destroyed. Wheat was planted 30 to 32 days after the last application. No additional application of the test substance was made to the rotated wheat.

Duplicate analyses were carried out on wheat sample matrices. Samples were analysed for bifenthrin. No residues were detected in any of the samples of wheat forage, hay, straw, and grain.

The methodology employed for bifenthrin analysis in/on all wheat matrices involved initial extraction of the analyte from the wheat matrix using acetone. The acetone was then evaporated and the remaining aqueous extract from the matrix was partitioned into hexane. The partitioned hexane fraction was then cleaned up with a silica gel SPE cartridge and analysed by GC/MSD. The LOQ was 0.05 mg/kg and the LOD was 0.01 mg/kg for all wheat samples. The average method recovery for bifenthrin in the study was 93 ± 10% (n = 12).

The untreated and treated wheat samples in this study were kept in frozen storage (~ -18 °C) for no more than seven months after sampling until analysis. A storage stability study for bifenthrin in/on corn (grain, silage and stover) which is also a member of the cereal grains crop group, has shown bifenthrin to be stable for at least 49 months under frozen storage (~ -18 °C) conditions. Thus, it can be concluded that bifenthrin is stable for at least six months in/on wheat matrices in this study.

Summary of degradation route of bifenthrin in soil

In aerobic conditions, the degradation of bifenthrin proceeds by hydrolysis and/or oxidation, resulting in the formation of a variety of metabolites and non-extractable residues and ultimately the formation of carbon dioxide. Soil residue studies showed that levels of organosoluble ^{14}C residues decreased with time as levels of PES increased. The data indicated that parent compound is the only relevant residue for quantification in soil. The main metabolite, 4'-OH bifenthrin, is always found in amounts largely lower than 10% of the total radioactivity. Other metabolites such as TFP acid, BP alcohol or BP acid mostly occurred in traces only. Soil bound residues are distributed among the various soil organic matter components humic acid, fulvic acid and humin. One year after application, these metabolites were merely noted in trace amounts, and there was no tendency for accumulation in soil as indicated by the results of soil residue studies including rotational crops planting. The metabolism pathway of bifenthrin in soil has been elucidated and is presented in Figure 4.

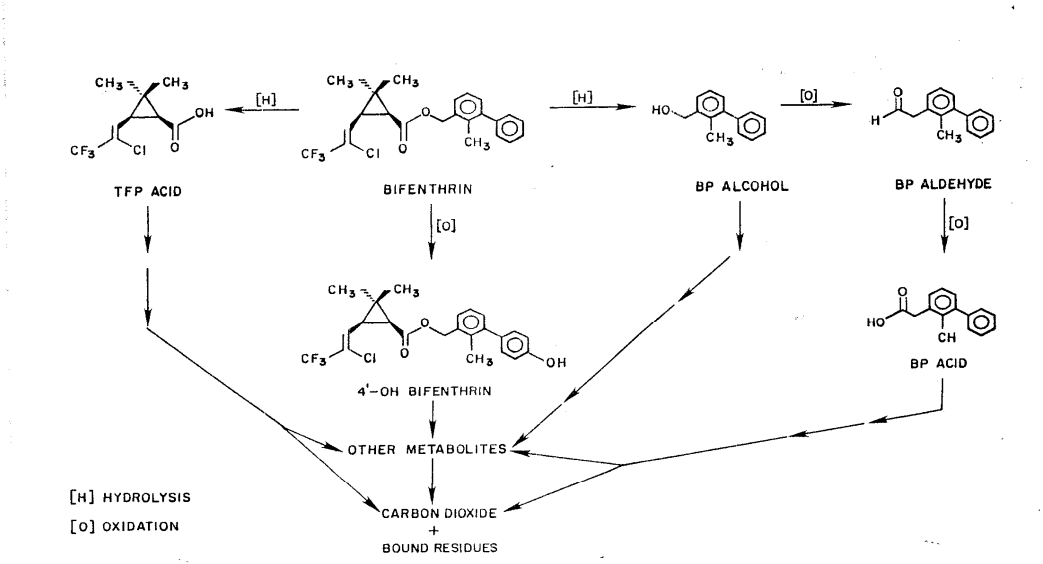


Figure 4 Proposed metabolic pathway of bifenthrin in soil

METHODS OF RESIDUE ANALYSIS

Validation extractability

The extractability of ^{14}C-radioactivity from milk and tissue (liver) was determined using samples from goats treated with either CP- or PH-labelled ^{14}C-bifenthrin (Akkari 1986, P-1327). TRR were determined initially and at each step of the procedure comprising an acetone blend, concentration/solvent transfer into hexane, and a hexane/water partition. Percent radioactivity recovered was comparable throughout the procedure for both the CP- and PH-^{14}C labelled bifenthrin. The results for milk showed that 90% and 100% of the initial extractable radioactivity were present in the post blend filtrate for the CP- and PH-^{14}C-bifenthrin, respectively (Table 32). At the partition step

practically all measured radioactivity remained in the hexane phase with overall recoveries of 100% ^{14}C radioactivity. The ^{14}C radioactivity extracted from liver by the 80:20 acetone: hexane solvent was lower than for milk. About 76% and 80% were measured in the filtrate for the CP- and PH-^{14}C labels, respectively. Recoveries of radioactivity in the hexane extract were better than 96% for both labels, after the aqueous/hexane partition. This high partition efficiency is a reflection of the very low solubility of bifenthrin in water.

The extractability of total ^{14}C radioactivity from milk by acetone, and from liver 80:20 (v/v) acetone: hexane was very efficient especially for milk. Liver had a higher percentage (~20%) of the radioactivity remaining in the PES. The results indicate that a solvent blend using acetone for milk and 80:20 acetone: hexane for liver, followed by filtration, concentration into hexane and hexane/water partition is an efficient scheme for extracting ages residues of bifenthrin from milk and tissues.

Table 32 Method validation extractability of TRR from goat milk and liver (P-1327)

	Aged residues of ^{14}C-bifenthrin in % of TRR			
	Milk		Liver	
Procedure step	CP-^{14}C label	PH-^{14}C label	CP-^{14}C label	PH-^{14}C label
After blending				
Extracted (filtrate)	89.7	100	76.4	80.2
Bound (filter cake)	10.3	0	23.6	19.8
After partitioning				
Hexane phase	100	100	98.6	96.5
Water phase	0	0	1.4	3.5

Analytical methods

The Meeting received descriptions and validation data for analytical methods for residues of bifenthrin in plant and animal commodities.

Residue analytical methods for bifenthrin rely on GC-ECD and GC-MSD. Typical LOQs achieved for plant and animal commodities fall in the range of 0.01-0.05 mg/kg. Methods have been subjected to independent laboratory validation.

Plant commodities

Apples (Enriquez 1999, A-01-99-05)

Analyte: bifenthrin Method: GC-MSD (m/z of 181) LOQ: 0.01 mg/kg

Description: Bifenthrin was extracted from 10 g of sample with a water-methanol-acetonitrile (2/1/4, v/v/v) mixture. After addition of NaCl, the bifenthrin was partitioned into dichloromethane. The dichloromethane was evaporated to dryness, and the residue was reconstituted in hexane and purified using a Florisil column. The final toluene solution was analysed by GC-MSD.

Apples, wheat grain and rape seed (Lakaschus 2006, FMC-0602V; Enriquez and Ferreira 2004, A-17-04-16)

Analyte: bifenthrin Method: GC-MSD, GC-ECD LOQ: 0.01 mg/kg

Description: In this study, the Multi-Residue Enforcement Method DFG S19 was independently validated for the analysis of bifenthrin in wheat grain (dry matrices), oilseed rape seed (oily matrices) and apple samples (watery/acidic matrices). The residues of bifenthrin were extracted according to the DFG S 19 Method extraction modules E3 for apple, E2 for wheat grain and E7 for oilseed rape seeds, cleaned up by GPC and silica gel column chromatography.

Cherries, French beans and pears (Enriquez 1999, A-17-98-40)

Analyte: bifenthrin Method: GC-ECD LOQ: 0.05 mg/kg

Description: Residues of Bifenthrin in cherries, French beans and pears were extracted with a mixture of water/methanol/acetonitrile (2:1:4). After addition of sodium chloride, partitioning to dichloromethane followed. After evaporation and re-dissolution in hexane, further clean up was performed on a Florisil column. Residues were eluted with ethyl acetate/hexane (2:98).

Cotton seed, ginned (Stearns1984, RAN-0140)

Analyte: bifenthrin Method: GC-ECD LOQ: 0.05 mg/kg

Description: The method involved an initial acetone extraction from a 20-g subsample of macerated crop and a two step hexane/salt water partition. The hexane fractions were combined, dried and concentrated, and then reconstituted in cyclohexane/methylene chloride (85/15, v/v), prior to cleanup by gel permeation chromatography. The cyclohexane/methylene chloride (85/15, v/v) eluate was concentrated and transferred to Florisil column. After elution with hexane/methyl t-butyl ether (9/1, v/v), the sample was then concentrated.

Cotton plants (Akkari 1988, P-1975M)

Analyte: bifenthrin Method: GC-ECD LOQ: 0.1 mg/kg

Description: The method of analysis of bifenthrin in cotton plants comprised an acetone blend, a polar to nonpolar solvent exchange, an aqueous/hexane extraction, purification by a Florisil column clean up, and a final purification utilizing Florisil solid phase extraction.

Flour and white bred (Roland 1998, 5-BIFENVAL98/10)

Analyte: bifenthrin Method: GC-ECD LOQ: 0.01 mg/kg

Description: Method MR-052-02-01 for the analysis of bifenthrin in flour and white bread was validated. The method involves an extraction of bifenthrin with acetone and evaporation of the solvent to about 10 mL. Purification was achieved by partition with water and extractions with hexane. After evaporation of the hexane phase, samples were cleaned up by a Florisil column run. The eluat was a mixture of hexane/diethylether (95/5, v/v).

Maize grain, fodder and silage (Pejovich 1985, RAN-0157)

Analyte: bifenthrin Method: GC-ECD LOQ: 0.05 mg/kg (grain), 0.1 mg/kg (silage), 0.5 mg/kg (stover)

Description: The method involved an initial acetone extraction from a 20 g subsample of grain, silage or stover, a two-step hexane/water partition, and drying and concentrating the subsequent hexane extracts for a Florisil open column cleanup. Bifenthrin was eluted from the Florisil column with hexane/methyl t-butyl ether (9/1, v/v). The eluate was concentrated and reconstituted in hexane prior to analysis.

Maize grain, silage and stover (Akkari 1987, P-1645M, P-1694M)

Analyte: bifenthrin, 4'-OH-bifenthrin Method: GC-ECD LOQ: 0.05 (grain), 0.1 (silage), 0.5 (stover) mg/kg

Description: The method of analysis for bifenthrin in maize involved an acetone blend extraction. After a water/hexane partition the hexane fractions were concentrated for a Florisil column clean-up. The column was eluted for bifenthrin with 100 mL of 5% (v/v) ethyl acetate in hexane.

The method of analysis for 4'-OH-bifenthrin in maize comprised the same procedures as in the method mentioned above with the exception that instead of the water/hexane partition a concentration into hexane was done prior to the Florisil column clean up.

Maize grain, silage and stover (Ridler 1995, P-2550M)

Analyte: bifenthrin, 4'-OH-bifenthrin Method: GC-ECD LOQ: 0.05 (grain), 0.1 (silage), 0.5 (stover) mg/kg

Description: The analytical method established for this study combined the two methods into one method which consists of an acetone blend, a liquid/liquid partition, a Florisil column clean-up and a solid phase (Florisil) clean-up, which produced a bifenthrin fraction and a separate 4'-OH bifenthrin fraction. Quantitation is performed by separate injections of each solution.

Maize grain, processed parts (Chen Wang 1990, P-2281M)

Analyte: bifenthrin Method: GC-ECD LOQ: 0.01 mg/kg

Description: The method for the non-oil fractions included an acetonitrile/water (50/50, v/v) extraction, C18 solid phase extraction and clean up by Florisil cartridge. For oil sample analysis a gel permeation chromatograph followed by acetonitrile/hexane partition and Silica cartridge clean up were used.

Oranges (Schreier 1998, RAN-0313M)

Analyte: bifenthrin Method: GC-MSD LOQ: 0.0005 mg/kg

Description: Whole orange samples were subjected to an initial acetone blend extraction. The extract was filtered and an aliquot was cleaned up with cyclohexyl solid phase extraction (SPE) followed by a strong anion exchange SPE. The eluate was concentrated prior to analysis.

Oilseed rape, plants and pods (Todd 1987, 73/67)

Analyte: bifenthrin Method: GC-ECD LOQ: 0.01 mg/kg

Description: Based on the methods of Witkonton (1983) the analytical procedure FMC/2421/M15/84 was validated for oil seed rape. Extraction was made by maceration with acetone followed by partition with hexane and aqueous sodium chloride. Sample clean-up was by a Florisil open column run. The column was eluted for bifenthrin with a 2% ethyl acetate/hexane mixture. After the addition of toluene the eluat was reduced in volume for determination.

Potatoes (Lucini 2006, SIP1504)

Analyte: bifenthrin Method: GC-ECD LOQ: 0.01 mg/kg

Description: Bifenthrin was extracted from 5 g of sample with acetone. After addition of NaCl, the bifenthrin was quantitatively partitioned into hexane. The combined hexane extracts were evaporated to dryness and the residue was reconstituted in hexane. The hexane phase was filtered, filled with anhydrous sodium sulphate and the filter rinsed with n-hexane. The filtrate was then collected in a round bottom flask and concentrated to dryness keeping the bath temperature below 40 °C. A chromatographic column was prepared loading 10 g of silica in a column with n-hexane, adding 3 g of sodium sulphate anhydrous on the top. The dry residue was dissolved in 2 × 1 mL of n-hexane and loaded onto the column. The silica was rinsed with 50 mL of n-hexane then with 25 mL of n-hexane/ethyl acetate mixture (90:10, v/v). The eluate was concentrated to near dryness then dissolved in acetone for analysis.

Strawberries, peaches and pears (Barnes, Troy and Olinger 1990, PC-0128)

Analyte: bifenthrin Method: GC-ECD LOQ: 0.05 mg/kg

Description: A method for the validation of bifenthrin in strawberries, peaches and pears was independently validated using FMC report number P-1073 for strawberries. Samples were homogenized then extracted with acetone followed by partitioning of the liquid portion with hexane. Hexane partition layers were passed through sodium sulfate and concentrated for Florisil column clean-up.

Tea, fresh, green and black (Gill 1996, FCC 0596)

Analyte: bifenthrin Method: GC-MSD (m/z 166 and 181), GC-ECD LOQ: 0.01 mg/kg

Description: Bifenthrin was extracted from 5 g of sample with acetone. After addition of NaCl, the bifenthrin was quantitatively partitioned into hexane. The combined hexane extracts were evaporated to dryness and the residue was reconstituted in hexane and purified using a Florisil column, eluting bifenthrin with diethyl ether/hexane (5/95, v/v). The ether was removed and the final volume was adjusted with hexane.

Various crops (Klumpp 2002, 20011318/01-RSS, 20011318/02-RWB, 20011318/01-RSBA, 20011318/02-RWW, 20011318/01-RSWH, 20011318/01-RRA, 20011318/02-RPS, 20011318/01-RWB, 20011318/01-RTR, 20011318/01-RWW, 20011318/01-RSA, 20011318/01-RPO; Klumpp 2003, 20011318/02-RPS)

Analyte: bifenthrin Method: GC-MSD (m/z = 181, 165, 166) LOQ: 0.01 mg/kg

Description: Fortification experiments were carried out with untreated samples from the field trials. Residues of bifenthrin were extracted after homogenisation with acetonitrile. The acetonitrile extract was further saturated with sodium chloride. An aliquot of the extract was dried with anhydrous sodium sulphate and evaporated to dryness. The sample extracts were dissolved in the elution mixture (hexane/ethylacetate; 8:2 (v/v)) and subsequently cleaned up by solid-phase extraction on graphitised carbon and a primary amino phase. Residues of bifenthrin were eluted with elution mixture. The eluate was evaporated to dryness and residues were re-dissolved in toluene.

Walnuts and pecans (Winkler 1992, PC-0130)

Analyte: bifenthrin Method: GC-ECD LOQ: 0.05 mg/kg

Description: The analytical method for bifenthrin described in FMC Reports P-1109 and RAN-0142 was independently validated for pecans and walnuts, with some modifications in clean-up steps. The validated analytical method included an acetone extraction, concentration by vacuum rotary evaporation, acetonitrile partition, hexane partition, Florisil column clean up.

Walnuts, peanuts and peanut processed parts as soapstock and oil (Chen 1999, P-2763)

Analyte: bifenthrin Method: GC-ECD LOQ: 0.05 mg/kg

Description: The analytical method listed in the FMC Report PC-0130 was modified and validated. Two different analytical procedures were developed, one for nutmeat and soapstock and the other for crude oil and refined oil. The assay method for bifenthrin on soapstock utilized an acetone extraction, vacuum filtration, acetonitrile partition, centrifugation, cyclohexane partition, silica gel cartridge solid phase extraction, and quantitation by GC-ECD.

The analytical procedure for bifenthrin on crude oil and refined oil consisted of an acetonitrile extraction, centrifugation, cyclohexane partition, silica gel cartridge solid phase extraction.

Recovery data from the internal and independent laboratory validation (ILV) testing for bifenthrin and metabolites in plant commodities are summarised in Table 33.

Table 33 Analytical recoveries for spiked bifenthrin and metabolites in various plant substrates

Substrate	Spiked analyte	Spike conc. mg/kg	N	Range Recovery %	Mean recovery %	Reference Report
Apples	Bifenthrin	0.05	2	96-114	105	Witkonton 1983, P-0757
		0.1	2	88-90	89	
		0.2	2	90-95	93	
		1.0	1		84	
		2.0	1		86	
Apples	Bifenthrin	0.01	5	81-108	90	Enriquez and Ferreira 2004 A-17-04-16
		0.1	5	75-89	82	
Apples	Bifenthrin	0.01	10	85-104	92	Enriquez 1999 A-01-99-05
		0.1	10	84-100	91	
Apples GC-ECD	Bifenthrin	0.01	5	97-105	100	Lakaschus 2006 FMC-0602V
		0.1	5	87-107	98	
Apples GC-MSD m/z 181	Bifenthrin	0.01	3	98-106	103	Lakaschus 2006 FMC-0602V
		0.1	3	104-109	106	
Apples GC-MSD m/z 182	Bifenthrin	0.01	3	96-111	105	Lakaschus 2006 FMC-0602V
		0.1	3	104-110	106	
Apples GC-MSD m/z 166	Bifenthrin	0.01	3	98-109	104	Lakaschus 2006 FMC-0602V
		0.1	3	103-109	106	
Cherries	Bifenthrin	0.05	3	71-96	84	Enriquez 1999 A-17-98-40
		0.5	5	92-100	95	
Cotton plants	Bifenthrin	1.0	1		76	Akkari 1988 P-1975M
		10	1		73	
Cotton seed	Bifenthrin	0.05	8	64-92	73	Stearns 1984 RAN-0140
		0.1	1		78	
French beans	Bifenthrin	0.05	3	75-84	79	Enriquez 1999 A-17-98-40
		0.5	3	72-84	76	
Maize grain	Bifenthrin	0.01	3	70-72	71	Chen Wang 1990 P-2281M
- Dry milling Course meal	Bifenthrin					Chen Wang 1990 P-2281M
		0.01	3	70-82	76	

Substrate	Spiked analyte	Spike conc. mg/kg	N	Range Recovery %	Mean recovery %	Reference Report
Flour		0.01	3	90-101	95	
Medium		0.01	3	83-98	89	
Crude oil		0.01	3	76-111	95	
Refined oil		0.01	3	97-121	107	
- Wet milling	Bifenthrin					Chen Wang 1990
Starch		0.01	3	90-106	100	P-2281M
Crude oil		0.01	3	70-114	94	
Refined oil		0.01	3	93-93	93	
Maize grain	Bifenthrin	0.05	6	78-96	89	Pejovich 1985
		0.1	4	69-98	84	RAN-0157
Maize grain	Bifenthrin	0.05	3	74-100	88	Akkari 1987
		0.10	3	74-100	106	P-1645M
Maize grain	Bifenthrin	0.5	1		84	Ridler 1989
		1.0	1		88	P-2132M
Maize grain	Bifenthrin	0.05	5	63-100	83	Ridler 1995
		0.1	6	80-111	90	P-2550M
Maize grain	4'-OH-bifenthrin	0.05	6	74-106	90	Ridler 1995
		0.1	6	65-105	86	P-2550M
Maize grain	4'-OH-bifenthrin	0.05	3	64-80	69	Akkari 1987
		0.10	3	64-80	96	P-1694M
Maize grain	4'-OH-bifenthrin	0.50	10	63-124	81	Culligan 1991 P-2533M
Maize silage	Bifenthrin	0.1	3	73-79	75	Pejovich 1985
		0.2	1		94	RAN-0157
		0.5	3	73-99	85	
		1.0	3	78-107	90	
		2.0	1		81	
		5.0	1		76	
Maize silage	Bifenthrin	0.1	3	59-107	80	Akkari 1987
		0.2	1		81	P-1645M
Maize silage	Bifenthrin	0.5	1		84	Ridler 1989
		1.0	1		94	P-2132M
Maize silage	4'-OH-bifenthrin	0.1	3	72-87	79	Akkari 1987 P-1694M
Maize silage	4'-OH-bifenthrin	0.5	9	64-102	84	Culligan 1991 P-2533M
Maize stover	Bifenthrin	0.5	3	82-116	96	Pejovich 1985
		1.0	2	80-88	84	RAN-0157
		2.0	1		76	
		5.0	1		66	
		10	1		83	
		15	1		90	
Maize stover	Bifenthrin	0.5	2	110-118	114	Akkari 1987
		2.5	1		102	P-1645M
Maize stover	Bifenthrin	0.5	1		114	Ridler 1989
		1.0	1		101	P-2132M
Maize stover	4'-OH-bifenthrin	0.5	3	70-81	75	Akkari 1987 P-1694M
Maize stover	4'-OH-bifenthrin	0.5	10	68-110	93	Culligan 1991 P-2533M
Oranges	Bifenthrin	0.005	2	74-75	74	Schreier 1998
		0.02	1		76	RAN-0313M
Peaches	Bifenthrin	0.05	3	82-95	89	Barnes et al. 1990
		0.25	3	94-94	94	PC-0128
		1.0	3	73-87	82	
Pears	Bifenthrin	0.05	3	82-91	85	Enriquez 1999
		0.5	3	76-83	80	A-17-98-40
Pears	Bifenthrin	0.05	2	108-116	112	Barnes et al. 1990
		0.25	3	74-108	91	PC-0128
		1.0	3	61-86	73	
Peas	Bifenthrin	0.01	2	90	90	Wasser 1994,
		0.05	1		103	RF 3076

Substrate	Spiked analyte	Spike conc. mg/kg	N	Range Recovery %	Mean recovery %	Reference Report
		0.1	1		95	
Peas, green plant	Bifenthrin	0.01	5	72-103	90	Klumpp 2002 20011318/01-RSS 20011318/02-RPS Klumpp 2003 20011318/01-RPS
		0.2	5	66-90	79	
Peas, dry seeds	Bifenthrin	0.01	5	71-98	83	
		0.1	5	86-85	77	
Peas, straw	Bifenthrin	0.01	5	78-88	83	
		0.1	6	57-94	80	
Potatoes	Bifenthrin	0.01	5	82-86	85	Klumpp 2002l 20011318/01-RPO
		0.1	5	90-96	93	
Rape plant	Bifenthrin	0.01	1		75	Todd 1987 73/67
		0.1	1		96	
		0.5	1		71	
		1.0	1		81	
Rape plant, green	Bifenthrin	0.01	5	86-106	99	Klumpp 2002 20011318/01-RRA 20011318/02-RRA
		0.1	5	85-88	87	
Rape plant	Bifenthrin	0.01	5	78-99	90	
		0.1	5	75-86	81	
Rape plant, straw	Bifenthrin	0.01	5	86-109	99	
		0.1	5	83-86	84	
Rape pod	Bifenthrin	0.01	1		93	Todd 1987 73/67
		0.1	1		89	
		0.5	1		87	
		1.0	1		94	
Rape seed	Bifenthrin	0.01	5	92-117	105	Enriquez and Ferreira 2004 A-17-04-16
		0.1	5	82-95	90	
Rape seed GC-ECD	Bifenthrin	0.01	5	84-102	90	Lakaschus 2006 FMC-0602V
		0.1	5	76-95	81	
Rape seed GC-MSD m/z 181	Bifenthrin	0.01	3	82-87	85	Lakaschus 2006 FMC-0602V
		0.1	3	78-86	82	
Rape seed GC-MSD m/z 182	Bifenthrin	0.01	3	77-89	83	Lakaschus 2006 FMC-0602V
		0.1	3	79-87	83	
Rape seed GC-MSD m/z 166	Bifenthrin	0.01	3	87-101	95	Lakaschus 2006 FMC-0602V
		0.1	3	78-84	80	
Strawberries	Bifenthrin	0.05	3	86-125	100	Barnes et al. 1990 PC-0128
		0.25	3	80-98	87	
		1.0	3	63-96	81	
Tea, fresh	Bifenthrin	0.01	1		91	Gill 1996 FCC 0596
		0.05	1		78	
		0.2	1		109	
Tea, green	Bifenthrin	0.01	1		120	Gill 1996 FCC 0596
		0.05	1		93	
		0.2	1		74	
Tea, black	Bifenthrin	0.01	1		83	Gill 1996 FCC 0596
		0.05	1		112	
		0.2	1		113	
Wheat grain GC-ECD	Bifenthrin	0.01	5	85-93	89	Lakaschus 2006 FMC-0602V
		0.1	5	77-90	85	
Wheat grain GC-MSD m/z 181	Bifenthrin	0.01	3	83-95	89	Lakaschus 2006 FMC-0602V
		0.1	3	82-87	85	
Wheat grain GC-MSD m/z 182	Bifenthrin	0.01	3	82-93	89	Lakaschus 2006 FMC-0602V
		0.1	3	83-88	86	
Wheat grain GC-MSD m/z 166	Bifenthrin	0.01	3	70-83	78	Lakaschus 2006 FMC-0602V
		0.1	3	84-86	85	
Wheat grain	Bifenthrin	0.01	5	74-101	86	Enriquez and Ferreira 2004 A-17-04-16
		0.1	5	101-120	109	
Wheat, barley green plant	Bifenthrin	0.01	5	92-103	97	Klumpp 2002 20011318/02-RWW 20011318/01-RSWH 20011318/01-RSBA 20011318/01-RWB
		0.3	5	75-93	88	
Wheat, barley, oat grain	Bifenthrin	0.01	6	76-100	91	
		0.1	6	80-89	83	
Wheat, barley, oat	Bifenthrin	0.01	6	74-99	87	

Substrate	Spiked analyte	Spike conc. mg/kg	N	Range Recovery %	Mean recovery %	Reference Report
straw		0.25	6	72-83	79	20011318/02-RWB 20011318/01-RTR 20011318/01-RWW
Wheat	Bifenthrin					Roland 1998
White flour		0.01	5	85-102	97	5-BIFENVAL98/10
		0.05	2	102-103	103	
		0.2	5	93-100	96	
White bread		0.01	5	72-89	82	Roland 1998
		0.2	5	79-96	86	5-BIFENVAL98/10
Whole meal bread		0.2	2	86-95	90	Roland 1998 5-BIFENVAL98/10
Bran		1.0	2	101-102	101.5	Roland 1998 5-BIFENVAL98/10

Animal commodities

Animal fat (Reichert 2006, IF-06-00690000)

Analyte: bifenthrin Method: GC-MSD LOQ: 0.05 mg/kg

Description: Five-gram portions of animal fat were quantitatively extracted at 80 °C from an ethyl acetate/cyclohexane (1/1, v/v) mixture. An aliquot of the final solution was cleaned-up using GPC, eluting with ethylacetate/cyclohexane (1/1, v/v). The collected eluate was concentrated and reconstituted in iso-octane prior to determination using GC/MS: Pesticides capillary column and a Thermo Electron Corporation Trace GC Ultra gas chromatograph coupled with a trace DSQ detector using negative chemical ionization (NCI) and single ion monitoring (SIM). For quantification the ion m/z 386 was used. Results were confirmed by ion m/z 205 and 241.

Animal fat (Lakaschus and Klimmek 2006, FMC-0606V)

Analyte: bifenthrin Method: GC-MSD LOQ: 0.05 mg/kg

Description: ILV of method IF-06/00690000.

Bovine kidney and liver (Senciuc and Class 2008, P-1549G)

Analyte: bifenthrin Method: LC-MS/MS LOQ: 0.01 mg/kg

Description: The method based on DFG S19, using the extraction E7 and the GPC clean up modules. Ten-gram portions of pre-homogenized beef or liver kidney samples were homogenized and extracted with Celite 545 and acetonitrile/acetone(9/1, v/v). An aliquot of the filtrate from the subsequent vacuum and gravity filtered suspension was concentrated to dryness, redissolved in acetonitrile water (1/1, v/v) and analysed by LC-MS/MS: HPLC system coupled with an electrospray-ionization tandem mass spectrometer. The characteristic 440→181 m/z transition was used for quantification, and the 440→166 m/z transition for confirmation.

Cow tissue, muscle (Enriquez 2004, A-17-04-18)

Analyte: bifenthrin Method: GC-ECD LOQ: 0.05 mg/kg

Description: This ILV was conducted using the FMC method reported by Akkari, 1984 (FMC Method No. P-1031). Bifenthrin was extracted from 20 g samples of cow muscle with

a mixture of acetone/hexane (80:20, v/v) followed by concentration into hexane. The hexane/aqueous partition was followed by GPC and Florisil column clean-up. Determination of bifenthrin was done by GC-ECD. Specificity was demonstrated using GC-MSD.

Cow tissue, muscle (Lakaschus 2006, FMC-0604V)

Analyte: bifenthrin Method: GC-ECD LOQ: 0.05 mg/kg

Description: 20 g of cow tissue (muscle) were extracted with acetone/hexane, an aliquot was evaporated and partitioned between water/hexane. A GPC clean up was performed and the solvent changed to hexane for a Florisil column clean up with an ethyl acetate/hexane elution.

Cow milk fat (Witkonton 1987, P-1703M)

Analyte: bifenthrin Method: GC-ECD LOQ: 0.2 mg/kg, equivalent to 0.008 mg/kg in whole milk based on 4% milk fat content

Description: The sample (whole milk) was blended with methanol, sodium oxalate, ethyl ether, and petroleum ether. The mixture was then centrifuged to separate protein precipitate. The isolated fat in the ethyl ether/petroleum ether phase was used for residue analysis. The fat was separated from bifenthrin residue using gel permeation chromatography column fractionation. The bifenthrin fraction was further cleaned up by Silica-gel and quantified using GC-ECD.

Cow milk and tissues (Ridler 1996, P-1031)

Analyte: bifenthrin Method: GC-ECD LOQ: 0.02 mg/kg (milk), 0.1 mg/kg (fat), 0.05 mg/kg (other tissues)

Description: The analytical procedure involved an acetone (for milk) or acetone/hexane 80:20, v:v (for tissues) blend with an ultrasonic extractor, followed by concentration into hexane. After a hexane/water partition the concentrated extract was cleaned up by a Florisil column run.

Cow milk and tissues (Witkonton 1987, P-1704M)

Analyte: biphenyl alcohol, biphenyl acid Method: GC-MSD LOQ: 0.02 mg/kg (milk), 0.05 mg/kg (tissues)

Description: <u>Biphenyl alcohol conjugate/cow tissue method</u>

Tissues were blended with acetone/methanol, 1:1. The extracting solvent was evaporated and the extract reconstituted in hexane. The hexane was subjected to aqueous partition before GPC fractionation. After a saponification step the released biphenyl alcohol was recovered in dichloromethane and cleaned up by Silica Gel prior to GC-MSD analysis. Selected ion monitor at ion 198 (biphenyl alcohol's m.w.) was used for quantification of residues.

<u>Biphenyl acid/cow tissue method</u>

Cow tissue was blended with acetone:methanol, 1:1. Acetone:methanol was evaporated to aqueous, diluted with water, and acidified. The aqueous acid was partitioned with dichloromethane. The dichloromethane extract was evaporated and

subjected to GPC fractionation. The collected GPC fraction containing BP acid (in dichloromethane) was cleaned up further by aqueous acid and base partitions. The dichloromethane was then evaporated and its residue containing BP acid was reacted with pentafluorobenzyl-bromide (PFBBr) in basic aqueous media. The post-derived mixture was cleaned up by Silica Gel. The final hexane extract was analysed by GC-MSD using selected ion monitor at ion 167 (biphenyl ring) of the BP acid pentafluorobenzyl derivative.

Cow milk (Lakaschus 2006, FMC-0607V)

Analyte: bifenthrin Method: GC-MSD LOQ: 0.01 mg/kg

Description: The DFG Method S19 (extended revision) Multi Method L00.00-34 of the Official Collection of Test Methods was used to determine bifenthrin residues in milk. The final solutions were analysed using GC-MSD at three different characteristic m/z ratios. The m/z 181 ion was used for quantification and the m/z 182 and m/z 166 ions were used for confirmation.

Milk (Reichert 2006, IF-06-00729840)

Analyte: bifenthrin Method: GC-MSD LOQ: 0.01 mg/kg

Description: ILV of DFG S19 for the determination of bifenthrin in milk. Residues of bifenthrin in milk were extracted with acetone/water and partitioned with ethyl acetate/cyclohexane. The extract was cleaned-up by GPC and solid phase chromatography (silica gel). The analyte in the final extract was determined using GC-MSD. For quantitation the ion m/z 181 was used. The results were confirmed by ion m/z 182 and 166.

Milk, bovine muscle, liver, kidney, fat (Schwarz 2008, P-1558G)

Analyte: biphenyl alcohol, biphenyl acid Method: LC-MS/MS LOQ: 0.01 mg/kg

Description: Twenty-five gram portions of pre-homogenized samples were extracted with an acetonitrile/acetone mixture (9/1, v/v), centrifuged, and cleaned up with dispersive C18 material. An aliquot of the resulting cleaned extract was evaporated to dryness. The residue was reconstituted with methanol/water (1/1, v/v) for final determination by reverse phase LC-MS/MS. The characteristic 181→165 m/z (biphenyl alcohol) and 211→165 m/z (biphenyl acid) MRM transitions were used for quantification, and the 181→166 m/z (biphenyl alcohol) and 211→167 m/z (biphenyl acid) MRM-transitions for confirmation.

Milk, bovine muscle, liver, kidney, fat (Zietz 2009, IF-09/01192270)

Analyte: biphenyl alcohol, biphenyl acid Method: LC-MS/MS LOQ: 0.01 mg/kg

Description: ILV of method P-1558G

Various cattle tissues (Barrett 1990, PM-2463M)

Analyte: non conjugated biphenyl alcohol Method: GC-MSD LOQ: 0.25 mg/kg

Description: The method reported is similar to previously mentioned methods addressing biphenyl

alcohol in cow tissues; however because the metabolite is in a non-conjugate form various analytical steps have been modified for this analysis. The basic procedure for biphenyl alcohol involves an initial acetone/methanol ultrasonication, followed by the concentration of the solvent extract into methylene chloride. A brine solution was added and the alcohol metabolite was methylene chloride partitioned and further cleaned up by GPC and silica gel.

Eggs (Leppert1987, RAN-0204M)

Analyte: bifenthrin Method: GC-ECD LOQ: 0.01 mg/kg

Description: Eggs were extracted with acetonitrile which was concentrated to a low volume, diluted with water, and partitioned into methylene chloride. The methylene chloride was concentrated to a small volume and then exchanged with hexane. The sample was cleaned up with a Florisil column and then analysed using GC-ECD.

Eggs (Gohre1987, RAN-0203M)

Analyte: hydroxymethyl bifenthrin, biphenyl alcohol Method: GC-MSD LOQ: 0.01 mg/kg

Description: The method for the determination of hydroxymethyl bifenthrin and biphenyl alcohol residues involved an initial acetone/hexane extraction of homogenised egg sample, concentration to a low volume and a hexane/water partition. The hexane fraction was replaced with 85/15, (v/v), cyclohexane/dichloromethane, and hydroxymethyl bifenthrin (found as fat soluble conjugate) separated from bifenthrin and free biphenyl alcohol by GPC. In a saponification step ethanolic KOH was added and the sample concentrated to a small volume. The dichloromethane fraction was cleaned up with Florisil and the released biphenyl alcohol derivatised with HFBA (heptafluorobutyric anhydride).

Eggs (Lakaschus and Klimmek 2006, FMC-0605V)

Analyte: bifenthrin Method: GC-ECD, GC-MSD LOQ: 0.01 mg/kg

Description: ILV of FMC method RAN-0204M (Leppert 1987). The residues were analysed with GC-ECD. GC-MSD was used as a confirmation method (not a step used in the original method). Three different m/z ions were used: 181 for quantification, 182, and 166 for verification.

Poultry tissues (Witkonton 1987, PM-1843M)

Analyte: bifenthrin, biphenyl alcohol Method: GC-MSD LOQ: 0.02 mg/kg (muscle), 0.05 mg/kg (others)

Description: Poultry tissue was ultrasonically blended with acetone/hexane, 1:1. The extracting solvent was evaporated and reconstituted in hexane. The hexane was partitioned with aqueous. The extract was further concentrated up to a volume of 10 mL with 85/15 (v/v) cyclohexane/dichloro-methane for GPC. The GPC fraction was evaporated and cleaned up by Silica Gel prior to GC-MSD.

Poultry tissues (Barrett 1987, PM-1883M)

Analyte: TFP Method: GC-MSD LOQ: 0.05 mg/kg (muscle), 0.01 mg/kg (liver)

Description: The method for the determination of TFP acid in poultry tissues was basically the same as for biphenyl acid (see above, Witkonton 1987, P-1704M) except that for blending acetone:hexane, 1:1 was used. The final hexane extract was then analysed by GC-MSD, monitoring the 197 (TFP) selected ion.

Recovery data from the internal and independent laboratory validation (ILV) testing for bifenthrin and metabolites in animal commodities are summarised in Table 34.

Table 34 Analytical recoveries for spiked bifenthrin and metabolites in various animal substrates

Substrate	Spiked analyte	Spike conc. mg/kg	N	Range Recovery %	Mean recovery %	Reference Report
Cattle milk m/z 181	Bifenthrin	0.01	5	84-96	91	Lakaschus 2006 FMC-0607V
		0.1	5	86-91	89	
Cattle milk m/z 182	Bifenthrin	0.01	5	70-98	84	Lakaschus 2006 FMC-0607V
		0.1	5	78-87	83	
Cattle milk m/z 166	Bifenthrin	0.01	5	79-95	89	Lakaschus 2006 FMC-0607V
		0.1	5	85-92	89	
Cattle milk m/z 181	Bifenthrin	0.01	5	89-97	93	Reichert 2006 IF-06-00729840
		0.1	5	83-99	91	
Cattle milk m/z 182	Bifenthrin	0.01	5	87-101	93	Reichert 2006 IF-06-00729840
		0.1	5	82-100	90	
Cattle milk m/z 166	Bifenthrin	0.01	5	88-105	95	Reichert 2006 IF-06-00729840
		0.1	5	82-100	91	
Cattle muscle	Bifenthrin	0.05	5	86-98	92	Enriquez 2004 A-17-04-18
		0.5	5	84-95	90	
Cattle muscle	Bifenthrin	0.05	3	110-134	119	Ridler 1996, P-1031
		0.1	3	72-121	91	
Liver	Bifenthrin	0.05	1		118	
		0.1	1		99	
Kidney	Bifenthrin	0.05	1		130	
		0.1	1		84	
Fat	Bifenthrin	0.5	1		72	
		1.0	2	81-90	86	
		2.0	1		70	
Milk	Bifenthrin	0.02	1		110	
		0.03	1		97	
		0.04	1		100	
		0.05	2	92-110	101	
		0.1	4	71-106	89	
		0.5	3	75-85	78	
		1.0	2	73-75	74	
Cattle fat	4'-OH-bifenthrin	0.5	10	70-118	95	Culligan 1991 P-2533M
Cattle liver	Biphenyl alcohol	0.25	2	73-88	80.5	Barrett 1990 P-2463M
		0.5	8	56-95	81	
Muscle	Biphenyl alcohol	0.25	1		82	Barrett 1990 P-2463M
		0.5	8	64-98	81	
Fat	Biphenyl alcohol	0.25	2	73-107	90	Barrett 1990 P-2463M
		0.5	8	54-138	83	
Cattle milk	Bifenthrin	0.2	2	100-113	106.5	Witkonton 1987 P-1703M
		0.4	1		101	
		0.8	1		103	
		1.0	2	94-108	101	
		1.5	1		102	
		2.0	1		102	
		3.0	1		93	
		7.0	1		97	
		9.0	2	94-101	97.5	
		10	2	84-87	85.5	

Substrate	Spiked analyte	Spike conc. mg/kg	N	Range Recovery %	Mean recovery %	Reference Report
Cattle milk	Biphenyl alcohol	0.02	5	50-110	71	Witkonton 1987 P-1704M
		0.05	5	55-114	77	
		0.1	1		102	
		0.2	1		92	
Cattle muscle	Biphenyl alcohol	0.05	5	56-86	76	Witkonton 1987 P-1704M
		0.1	5	54-94	73	
		0.2	4	64-94	84	
Liver	Biphenyl alcohol	0.05	2	66-108	87	Witkonton 1987 P-1704M
		0.1	2	65-96	81	
		0.2	1		120	
Kidney	Biphenyl alcohol	0.05	2	72-90	81	Witkonton 1987 P-1704M
		0.1	2	84-96	90	
		0.2	2	67-96	82	
Fat	Biphenyl alcohol	0.05	3	64-88	76	Witkonton 1987 P-1704M
		0.1	3	67-82	76	
		0.2	3	77-94	86	
		0.4	1		71	
		0.5	1		85	
		1.0	1		78	
Cattle muscle	Biphenyl acid	0.05	3	60-84	71	Witkonton 1987 P-1704M
		0.1	3	86-93	89	
		0.2	1		98	
Liver	Biphenyl acid	0.05	2	82-106	94	Witkonton 1987 P-1704M
		0.1	2	66-80	73	
		0.2	2	78-111	95	
Kidney	Biphenyl acid	0.05	2	82-108	95	Witkonton 1987 P-1704M
		0.1	2	79-97	88	
		0.2	2	80-112	96	
Fat	Biphenyl acid	0.05	2	76-78	77	Witkonton 1987 P-1704M
		0.1	2	73-76	75	
		0.2	1		79	
Cattle fat	Bifenthrin	0.05	5	83-93	89	Reichert 2006a IF-06-00690000
		0.5	5	77-90	83	
Cattle fat m/z 181	Bifenthrin	0.05	5	88-96	92	Lakaschus and Klimmek 2006 FMC-0606V
		0.5	5	88-96	92	
Cattle fat m/z 182	Bifenthrin	0.05	5	89-96	91	Lakaschus and Klimmek 2006 FMC-0606V
		0.5	5	88-95	92	
Cattle fat m/z 166	Bifenthrin	0.05	5	86-114	97	Lakaschus and Klimmek 2006 FMC-0606V
		0.5	5	90-96	93	
Bovine liver m/z 181	Bifenthrin	0.01	5	78-98	89	Sencius and Class 2008, P1549G
		0.1	5	78-103	88	
Bovine liver m/z 166	Bifenthrin	0.01	5	84-97	91	Sencius and Class 2008, P1549G
		0.1	5	80-103	89	
Bovine kidney m/z 181	Bifenthrin	0.01	5	92-101	96	Sencius and Class 2008, P1549G
		0.1	5	88-98	94	
Bovine kidney m/z 166	Bifenthrin	0.01	5	89-99	94	Sencius and Class 2008, P1549G
		0.1	5	88-97	94	
Bovine liver m/z 165	Biphenyl alcohol	0.01	5	64-69	66	Schwarz 2008 P1558G
		0.1	5	58-66	62	
Bovine liver m/z 166	Biphenyl alcohol	0.01	5	65-70	68	Schwarz 2008 P1558G
		0.1	5	59-67	64	
Bovine muscle m/z 165	Biphenyl alcohol	0.01	5	79-85	83	Schwarz 2008 P1558G
		0.1	5	81-90	86	
Bovine muscle m/z 166	Biphenyl alcohol	0.01	5	77-81	79	Schwarz 2008 P1558G
		0.1	5	80-86	82	
Bovine kidney m/z 165	Biphenyl alcohol	0.01	5	72-83	78	Schwarz 2008 P1558G
		0.1	5	88-93	90	
Bovine kidney m/z 166	Biphenyl alcohol	0.01	5	72-84	78	Schwarz 2008 P1558G
		0.1	5	76-93	84	

Substrate	Spiked analyte	Spike conc. mg/kg	N	Range Recovery %	Mean recovery %	Reference Report
Bovine fat m/z 165	Biphenyl alcohol	0.01	5	70-78	74	Schwarz 2008 P1558G
		0.1	5	83-86	85	
Bovine fat m/z 166	Biphenyl alcohol	0.01	5	71-75	73	Schwarz 2008 P1558G
		0.1	5	84-87	85	
Milk m/z 165	Biphenyl alcohol	0.01	5	75-92	84	Schwarz 2008 P1558G
		0.1	5	75-88	82	
Milk m/z 166	Biphenyl alcohol	0.01	5	77-86	82	Schwarz 2008 P1558G
		0.1	5	79-85	82	
Bovine liver m/z 165	Biphenyl acid	0.01	5	77-86	80	Schwarz 2008 P1558G
		0.1	5	70-86	80	
Bovine liver m/z 167	Biphenyl acid	0.01	5	86-118	102	Schwarz 2008 P1558G
		0.1	5	79-86	82	
Bovine muscle m/z 165	Biphenyl acid	0.01	5	109-110	109	Schwarz 2008 P1558G
		0.1	5	102-113	108	
Bovine muscle m/z 167	Biphenyl acid	0.01	5	103-110	107	Schwarz 2008 P1558G
		0.1	5	105-114	109	
Bovine kidney m/z 165	Biphenyl acid	0.01	5	75-85	79	Schwarz 2008 P1558G
		0.1	5	84-102	89	
Bovine kidney m/z 167	Biphenyl acid	0.01	5	75-87	80	Schwarz 2008 P1558G
		0.1	5	85-100	90	
Bovine fat m/z 165	Biphenyl acid	0.01	5	96-103	99	Schwarz 2008 P1558G
		0.1	5	97-103	100	
Bovine fat m/z 167	Biphenyl acid	0.01	5	90-131	105	Schwarz 2008 P1558G
		0.1	5	101-109	106	
Milk m/z 165	Biphenyl acid	0.01	5	107-112	109	Schwarz 2008 P1558G
		0.1	5	99-114	108	
Milk m/z 167	Biphenyl acid	0.01	5	100-115	107	Schwarz 2008 P1558G
		0.1	5	100-110	108	
Poultry eggs	Bifenthrin	0.01	4	66-97	84	Leppert 1987 RAN-0204M
		0.025	4	84-118	96	
		0.05	4	84-93	89	
Poultry eggs	Bifenthrin	0.01	5	74-93	83	Lakaschus and Klimmek 2006 FMC-0605V
		0.1	5	83-96	90	
Poultry eggs m/z 181	Bifenthrin	0.01	3	75-89	81	Lakaschus and Klimmek 2006 FMC-0605V
		0.1	3	82-92	88	
Poultry eggs m/z 182	Bifenthrin	0.01	3	89-103	94	Lakaschus and Klimmek 2006 FMC-0605V
		0.1	3	83-94	90	
Poultry eggs m/z 166	Bifenthrin	0.01	3	78-91	83	Lakaschus and Klimmek 2006 FMC-0605V
		0.1	3	83-92	89	
Poultry eggs	Biphenyl alcohol	0.01	3	87-101	85	Gohre 1987 RAN-0203M
		0.025	1		81	
		0.05	1		91	
Poultry muscle	Bifenthrin	0.02	2	65-85	75	Witkonton 1987 P-1843M
		0.05	1		64	
		0.1	1		70	
Poultry fat	Bifenthrin	0.05	1		100	Witkonton 1987 P-1843M
		0.1	1		81	
		0.2	1		94	
Poultry liver	Bifenthrin	0.05	1		90	Witkonton 1987 P-1843M
		0.1	1		71	
		0.2	1		92	
Poultry gizzard	Bifenthrin	0.05	1		88	Witkonton 1987 P-1843M
		0.1	1		92	
		0.2	1		81	
Poultry muscle	Biphenyl alcohol	0.02	1		120	Witkonton 1987 P-1843M
		0.05	2	96-114	105	
		0.1	1		103	
		0.2	1		122	

Substrate	Spiked analyte	Spike conc. mg/kg	N	Range Recovery %	Mean recovery %	Reference Report
Poultry fat	Biphenyl alcohol	0.05	2	86-98	92	Witkonton 1987
		0.1	2	95-97	96	P-1843M
		0.2	1		88	
Poultry liver	Biphenyl alcohol	0.05	1		96	Witkonton 1987
		0.1	1		104	P-1843M
		0.2	1		114	
Poultry gizzard	Biphenyl alcohol	0.05	1		71	Witkonton 1987
		0.1	1		95	P-1843M
		0.2	1		80	
Poultry liver	TFP acid	0.05	2	68-80	74	Barrett 1987
		0.1	2	57-98	78	P-1883M

Stability of residues in stored analytical samples

Information was received on the freezer storage stability of bifenthrin residues in plant and animal commodities.

Table 35 Freezer storage stability data for bifenthrin spiked into plant and animal matrices

Matrix	Fortification level, mg/kg	No of analysis	Storage T, °C	Duration months	% Remaining	Mean %	Report
Lemons, whole fruit	0.50	5	- 18	7	92, 107, 110, 118, 125	110	P-2590
Oranges, Whole fruit	0.50	1 1 1 1	- 18	0 6 12 18	112 94 122 90	112 94 122 90	P-3474
Oranges, dried pulp	0.50	1 1 1 1	- 18	0 6 12 18	88 86 78 84	88 86 78 84	P-3474
Orange juice	0.50	1 1 1 1	- 18	0 6 12 18	90 80 84 86	90 80 84 86	P-3474
Orange oil	0.50	1 1 1 1	- 18	0 6 12 18	74 72 82 66	74 72 82 66	P-3474
Apples	1.0	5 1 1 1	- 18	0 3 6 12	59-80 102 76 77	70 102 76 77	P-1268
Apples	0.25 0.5	1 1	- 18	24 24	94 90	94 90	P-1459
Apples	1.0	3 3	- 18	0 49	102, 111, 115 80, 87, 92	109 86	P-2132
Strawberry	0.01 0.05 0.1 0.5	1 1 1 1	- 18	7 7 7 7	101 93 102 102	101 93 102 102	AD/5218/FM
Banana, whole fruit	0.5	1 1 1 1 1 1	- 18	0 1 3 6 12 24	96 92 82 98 96 96	96 92 82 98 96 96	P-3428
Banana, pulp	0.1	1 1 1 1 1	- 18	0 1 3 6 12	90 90 90 80 90	90 90 90 80 90	P-3428

Matrix	Fortification level, mg/kg	No of analysis	Storage T, °C	Duration months	% Remaining	Mean %	Report
		1		24	100	100	
Lettuce	0.25 0.50	2 6	- 18	24	95-106 91-98	95	P-2373
Lettuce	0.50	2	- 18	36	98-99	98	P-2373/Add
Potato	0.25 0.50	2 6	- 18	24	70-88 77-88	81	P-2373
Potato	0.50	2	- 18	36	88-93	81	P-2373/Add
Pecan	0.25 0.50	2 6	- 18	24	83-83 66-93	83	P-2373
Pecan	0.50	2	- 18	36	88-94	91	P-2373/Add
Peas, dry	0.10	4 2 2 3	- 18	0 5 8 15	87, 89, 90, 90 81, 85 76, 78 81, 85, 90	89 83 77 85	20011318/01-RSS
Maize grain	0.10	1 1	- 18	6 12	103 90	103 90	P-2479
Maize grain	0.5	3	- 18	9 34	82, 90, 92 86, 92, 78	44 43	P-2132
Maize flour	0.10	1 1	- 18	6 12	92 99	92 99	P-2479
Maize meal	0.10	1 1	- 18	6 12	94 106	94 106	P-2479
Maize starch	0.10	1 1	- 18	6 12	86 100	86 100	P-2479
Maize oil	0.10	1 1	- 18	6 12	95 108	95 108	P-2479
Maize silage	1.0	5 1 1 1	- 18	0 3 6 12	64-103 94 70 69	80 75 88 91	P-1268
Maize silage	0.5 1.0	1 1	- 18	24 24	71 86	84	P-1459
Maize silage	1.0	3 3 3 3 3 3	- 18	0 3 6 12 24 49	81, 104, 108 74, 81, 70 86, 82, 97 85, 94, 94 90, 81, 82 91, 88, 98	98 75 88 91 84 92	P-2132
Maize stover	1.0	5 1 1 1	- 18	0 3 6 12	62-91 80 73 68	80 93 88 96	P-1268
Maize stover	0.5 1.0	1 1	- 18	24 24	84 82	101	P-1459
Maize stover	1.0	3 3 3	- 18	0 3 6 12 24 49	111, 78, 111 88, 102, 90 86, 82, 97 87, 101, 100 93, 114, 96 84, 87, 75	100 93 88 96 101 82	P-2132
Cotton seed	0.5	5 1 1 1	- 18	0 3 6 12	80-99 62 81 80	92 62 81 80	P-1268
Cotton seed	0.25 0.5	1 1	- 18	24 24	78 69	86	P-1459
Cotton seed	0.5	3 3 3 3 3 3	- 18	0 3 6 12 24 49	98, 108, 88 98, 126, 118 94, 102, 96 96, 94, 102 94, 72, 90 66, 64, 60	60	P-2132

Matrix	Fortification level, mg/kg	No of analysis	Storage T, °C	Duration months	% Remaining	Mean %	Report
Cow milk	0.25 0.50	2 6	- 18	24	83-86 85-99	91	P-2373
Cow milk	0.50	2	- 18	36	61-77	69	P-2373/Add
Cow muscle	0.25 0.50	2 6	- 18	24	86-96 82-98	89	P-2373
Cow muscle	0.50	2	- 18	36	106-121	114	P-2373/Add
Cow liver	0.25 0.50	2 6	- 18	24	60-94 81-95	86	P-2373
Cow liver	0.50	2	- 18	36	87-87	87	P-2373/Add
Cow fat	0.25 0.50 1.25 2.50	1 5 1 1	- 18	24	119 75-104 112 105	94	P-2373
Cow fat	0.50	2	- 18	36	102-116	109	P-2373/Add
Poultry eggs	0.25 0.50	2 6	- 18	24	78-117 59-94	84	P-2373
Poultry eggs	0.50	2	- 18	36	77-82	79	P-2373/Add

USE PATTERN

Bifenthrin is registered in many countries for control of insect pests on fruit, vegetables, cereals, oilseeds and forage crops. Copies of bifenthrin labels from the following countries were made available to the Meeting in February 2010: Australia, Belgium, Brazil, P. R. of China, Columbia, Costa Rica, Ecuador, France, Germany, Greece, Guatemala, Honduras, Hungary, Israel, Italy, Japan, Korea, Mexico, Panama, Poland, Spain, South Africa, Switzerland, Taiwan, the UK and the USA. The information available to the Meeting on registered uses is summarised in Table 36.

The Meeting was informed on the decision by the EU Commission that bifenthrin was not included in Annex I to Directive 91/414/EEC and that authorisations for plant protection products containing bifenthrin are withdrawn by 30 May 2010 for all EU Member States (Vassiliou, 2009; 2009/887/EC). The uses of bifenthrin in the EU Member States are indicated in Table 36 as "pending".

Table 36 Registered uses of bifenthrin

Crop	Country	Application						
		Form	Type	Max rate kg ai/ha	Max conc kg ai/hL	Max per season kg ai/ha	Max number	PHI days
Apples	Australia	SC	Foliar during blossom		0.0008-0.002		1	
Almonds	Israel	EC	Foliar		0.075			30
Apricots	Australia	EC	Foliar		0.005			1
Banana	Australia	EC, SC	Soil spray		0.025-0.066			1
Banana	Australia	EC	Foliar		0.004			8
Banana	Columbia Costa Rica Ecuador Guatemala Honduras Panama	Biflex tree bags 0.1%	Placing the bag over the bunch before flower stalk shows first hand, leave the bag over the bunch until harvest	1 bag 0.1%		1 bag/ bunch	1 bag/ cluster	
Banana	Spain (pending)	EC	Spraying around the plant	0.00025 kg/plant				
Barley	Australia	EC	Foliar,	0.005-				

Crop	Country	Application						
		Form	Type	Max rate kg ai/ha	Max conc kg ai/hL	Max per season kg ai/ha	Max number	PHI days
			28 days before grazing or feeding	0.02				
Barley	Italy (pending)	SC	Foliar	0.0072				
Barley	Poland (pending)	EC	Foliar	0.0075-0.01				7
Barley	UK (pending)	SC	Foliar, before BBCH 73	0.0064		0.0152		
Beans, faba	Australia	EC	Foliar, 28 days before grazing or feeding	0.005-0.02				
Beans, navy (common beans, dry)	Australia	EC	Foliar, 14 days before grazing or feeding	0.06-0.08				14
Beans	France (pending)	SC	Foliar	0.04				7
Beans	Germany (pending)	SC	Foliar	0.01			1	14
Beans	Greece (pending)	EC, SC	Foliar		0.001-0.004		1-2	5
Beans	Poland (pending)	EC	Foliar	0.02				7
Beans	Spain (pending)	EC	Foliar	0.024-0.048				3
Beans	USA	EC	Foliar	0.028–0.11		0.22		3, 14 for dried beans
Beans	USA	WP	Foliar	0.028–0.11		0.22		3
Beans	USA	SC	Foliar	0.034–0.048		0.15		7
Beans	USA	WP	In-furrow at seeding or at transplant	0.056–0.11			1	
Beans	USA	GR		0.045–0.11		0.22		3, 9 if harvested by hand
Beans	USA	SC	In-furrow at seeding or at the soil surface in band over the open furrow	0.045-0.11		0.11		
Beans	USA	SC	Broadcast over the soil surface	0.045-0.09		0.11		
Brassica veg	Italy (pending)	SC	Foliar	0.01–0.03				7
Brassica veg	Italy (pending)	GR	In-furrow at seeding or at transplant	0.004-0.005				7
Brassica veg	Spain (pending)	EC	Foliar	0.02				7
Brassica	Switzerland	EC		0.03-				14

Crop	Country	Application						
		Form	Type	Max rate kg ai/ha	Max conc kg ai/hL	Max per season kg ai/ha	Max number	PHI days
veg				0.04				
Brassica veg	USA	EC, SC, WP, GR	Foliar	0.034–0.11		***0.56***	***5 (after bloom)***	7
Brassica veg	USA	SC, WP	In-furrow at seeding or at transplant	0.06–0.11		***0.11***		
Brassica leafy veg	USA	EC	Foliar	0.037–0.11		0.45		7
Brassica leafy veg	USA	SC	Foliar	0.037–0.054		0.27	5	7
Brassica leafy veg	USA	SC	In-furrow at seeding or at the soil surface in band over the open furrow	0.045-0.11		0.11		
Brassica leafy veg	USA	SC	Broadcast over the soil surface	0.045-0.09		0.11		
Brassica leafy veg	USA	EC	Foliar or aerial	0.037–0.054		0.45		7
Broad bean	France (pending)	SC	Foliar	0.008-0.02				7
Brussels sprouts	Belgium (pending)	SC		0.02			1	7
Brussels sprouts	UK (pending)	SC	Foliar	0.0076		0.03		2
Cabbages, head	France (pending)	SC	Foliar	0.02				7
Cabbages, head	Japan	WP	Foliar	0.02–0.03	0.0013-0.002	0.08–0.12	4	21
Cabbages, head	Poland (pending)	EC	foliar	0.02				7
Cabbages, head	UK (pending)	SC	Foliar	0.0076		0.03		2
Cabbages, head	USA	WP, EC	Foliar	0.037–0.11		0.56	5 (after bloom)	7
Cabbage	Japan	WP			0.0013-0.002		4	21
Caneberries (black-, dew-logan-, rasp-berries)	USA	EC, WP	Foliar	0.056–0.11		0.22	2	3
Carrot	Italy (pending)	SC	Foliar	0.02–0.03	0.002–0.003			7
Carrot	Italy (pending)	GR	In-furrow at seeding or at transplant	0.004-0.005				7
Carrot	Switzerland	EC		0.04				28
Cauliflower	UK (pending)	SC	Foliar	0.0076		0.03		2
Cereals	France (pending)	SC	Foliar	0.005-0.01				
Cereals	Germany (pending)	SC	Foliar	0.008			1	35
Cereals	Germany (pending)	SC	Broadcast	0.01			1	35
Cereals	Hungary	EC	Foliar	0.01				35

Crop	Country	Application						
		Form	Type	Max rate kg ai/ha	Max conc kg ai/hL	Max per season kg ai/ha	Max number	PHI days
	(pending)							
Cereals	Switzerland	EC	Foliar	0.02				42
Citrus fruits	Brazil	EC	Foliar	0.014-0.036	0.0008-0.002			7
Citrus fruits	Japan	SC, WP	Foliar		0.001-0.002		3	1
Citrus fruits	Spain (pending)	EC	Foliar spray using 1000–1500 L/ha	0.06-0.12	0.003-0.008			21
Citrus fruits	USA	SC	By ground to bare soil beneath citrus trees. Do not apply to fruit or foliage	0.11-0.56		0.56		
Citrus fruits	USA	EC, WP	Apply to bare soil beneath citrus trees	0.11–0.56		0.56		1
Clover	Australia	EC	Foliar, 28 days before graze or feed	0.005-0.02				
Cotton	Australia	EC	Foliar or in-furrow, do not graze or cut for feed, do not feed cotton trash to livestock	0.038-0.08				14
Cotton	Brazil	EC	Foliar	0.03-0.1			5	15
Cotton	Greece (pending)	SC 80 g/L	Foliar	50–100 mL/hL	0.004-0.008		1-2	21
Cotton	Greece (pending)	EC 100 g/L	Foliar application at 1st visible infection	40–80 mL/hL	0.004-0.008		1-2	21
Cotton	South Africa	EC	Foliar	0.03-0.04				28
Cotton	South Africa	EC	Tramline treatment	0.004 kg /1000 m row				28
Cotton	Spain (pending)	EC	Foliar	0.08				21
Cotton	USA	EC	Foliar	0.022–0.11		0.56		14
Cotton	USA	SC	Foliar	0.034–0.067		0.35		14
Cotton	USA	GR	Foliar	0.045–0.11		0.56		14
Cucumber	Japan	SC, WP	Foliar		0.002		3	1
Cucurbits	Australia	EC	Foliar	0.04-0.08	0.004-0.008			1
Egg plant	Israel	EC	Foliar	0.05				7
Egg plant	Italy (pending)	EC, SC	Foliar		0.002-0.004		2	7
Egg plant	Italy	GR	In-furrow at	0.004-				7

Crop	Country	Application						
		Form	Type	Max rate kg ai/ha	Max conc kg ai/hL	Max per season kg ai/ha	Max number	PHI days
	(pending)		seeding or at transplant	0.005				
Egg plant	Spain (pending)	EC	Foliar	0.028-0.056				3
Egg plant	USA	EC, WP	Foliar	0.034–0.11		0.22		7
Egg plant	USA	SC	Foliar	0.034–0.084		0.22		7
Egg plant	USA	GR		0.045–0.11		0.22		9
Egg plant	USA	SC	In-furrow at seeding or at the soil surface in band over the open furrow	0.09-0.11		0.11		
Egg plant	USA	SC	Broadcast over the soil surface	0.045-0.09		0.11		
Grapes	Australia	EC			0.0001			
Grapes	Japan	SC, WP	Foliar	0.002	0.002		2	14
Hazelnuts	Italy (pending)	SC	Foliar	0.02				14
Hazelnuts	Spain (pending)	EC	Foliar	0.024-0.064				30
Hazelnuts	Spain (pending)	EC	Foliar	0.048-0.064	0.06-0.08			30
Hops	Japan	WP	Foliar		0.002		2	30
Hops	UK (pending)	SC	Foliar	0.09			5	10
Hops	USA	EC, WP	Directed spray to base of plant.	0.056–0.11		0.34		14
Hops	USA	EC, WP	Foliar	0.067–0.11		0.34		14
Lemons	Italy (pending)	SC	Ground spray		0.004			21
Lemons	Italy (pending)	EC, SC	Foliar		0.002-0.006			21
Lentils	France (pending)	SC	Foliar	0.02			2	14
Lucerne	Australia	EC	Foliar, 28 days before grazing or feeding	0.005-0.02				
Lupins	Australia	EC	Foliar, 28 days before grazing or feeding	0.005-0.02				
Maize	France (pending)	SC	Foliar	0.012-0.03				14
Maize	Italy (pending)	EC, SC	Foliar	0.02				42 (7 sweet corn)
Maize	Italy (pending)	GR	In-furrow at seeding or at transplant	0.004-0.005				42 (7 sweet corn)

Crop	Country	Application						
		Form	Type	Max rate kg ai/ha	Max conc kg ai/hL	Max per season kg ai/ha	Max number	PHI days
Maize	USA	EC	Spraying over an open seed furrow	0.0034-0.007 kg /1000 m of row		0.11	1	30
Maize	USA	EC	Soil treatment, pre-emergence	0.045		0.34		30
Maize	USA	EC	Foliar	0.036–0.11		0.34		30
Maize	USA	GR	In-furrow	0.003-0.01 kg /1000 m of row		0.11		
Maize	USA	SC	At plant as band over an open furrow or in furrow with the seed	0.045-0.11		0.11		
Maize	USA	SC, EC	Pre-plant incorporation	0.053-0.07		0.34		
Maize	USA	SC	Pre-emergence	0.045		0.11		
Maize	USA	GR	Foliar broadcast	0.045–0.11		0.34		30
Mango [a]	Mali (no label)	EC	Foliar	0.05			2	7
Mango [a]	Senegal (no label)	EC	Foliar	0.05			2	7
Melons	Japan	WP	Foliar		0.002		4	1
Nectarines	Australia	EC	Foliar		0.005			1
Oats	UK (pending)	SC	Foliar, before BBCH 73	0.0064		0.015		
Oats	UK (pending)	EC, UL	Stored grain	0.0003 kg/ton		0.0003 kg/ton		
Okra [a]	Ivory Cost (no label)	EC	Foliar	0.04			2	2
Oranges	Italy (pending)	SC	Ground spray		0.004			21
Oranges	Italy (pending)	EC, SC	Foliar		0.002-0.006			21
Papaya [a]	Ghana (no label)	EC	Foliar	0.05			4	3
Papaya [a]	Ivory Coast (no label)	EC	Foliar	0.05			4	3
Peach	Australia	EC	Foliar		0.005			1
Pear	Australia	EC	Foliar		0.0025-0.004			14
Pear	Japan	SC, WP	Foliar		0.001-0.002		2	1
Peas, field	Australia	EC	Foliar, 28 days before grazing or feeding	0.005-0.02				
Peas	Belgium (pending)	SC	Foliar	0.008			1	7, 14 for dried
Peas	France	SC	Foliar	0.008-				3

Crop	Country	Application						
		Form	Type	Max rate kg ai/ha	Max conc kg ai/hL	Max per season kg ai/ha	Max number	PHI days
	(pending)			0.02				
Peas	Germany (pending)	SC	Foliar	0.008 – 0.01			2	7
Peas	Hungary (pending)	EC	Foliar	0.02				7
Peas	Poland (pending)	EC	Foliar	0.02				7
Peas	UK (pending)	SC	Foliar	0.0076		0.015		3
Peas	USA	EC	Foliar	0.028– 0.11		0.22		3, 14 for dried
Peas	USA	WP	Foliar	0.028– 0.11		0.22		3
Peas	USA	WP	In-furrow at seeding or at transplant	0.056– 0.11		0.11	1	
Peas	USA	SC	Foliar	0.045– 0.048		0.15		7
Peas	USA	GR		0.045– 0.11		0.22		3, 9 if harvested by hand
Peas	USA	SC	In-furrow at seeding or at the soil surface in band over the open furrow	0.09- 0.11		0.11		
Peas, succulent	USA	SC	Broadcast over the soil surface	0.045- 0.09		0.11		
Pecan	Israel	EC	Foliar		0.05			30
Peppers	Greece (pending)	EC, SC	Foliar		0.001-0.004		1-2	5
Peppers	Hungary (pending)	EC	Foliar	0.02- 0.04				10
Peppers	Israel	EC	Foliar	0.075				7
Peppers	Italy (pending)	EC; SC	Foliar		0.002-0.004		2	14
Peppers	Italy (pending)	GR	In-furrow at seeding or at transplant	0.004- 0.005				14
Peppers	Spain (pending)	EC	Foliar	0.028- 0.056				3
Pepper (bell and non-bell)	USA	EC, WP	Foliar	0.037– 0.11		0.22		7
Peppers	USA	SC	Foliar	0.022– 0.084		0.22		7
Peppers	USA	GR		0.045– 0.11		0.22		7
Peppers	USA	SC	In-furrow at seeding or at the soil surface in band over the open furrow	0.045- 0.11		0.11		
Peppers	USA	SC	Broadcast over the soil surface	0.045- 0.09		0.11		

Crop	Country	Application						
		Form	Type	Max rate kg ai/ha	Max conc kg ai/hL	Max per season kg ai/ha	Max number	PHI days
Plums	Australia	EC	Foliar		0.005			1
Potato	Belgium (pending)	SC	Foliar	0.01			1	7
Potato	Brazil	EC	Soil	0.1			2	35
Potato	Brazil	EC	Foliar	0.025–0.05				7
Potato	Germany (pending)	SC	Foliar	0.01			1-2	7
Potato	Hungary (pending)	EC	Foliar	0.015				35
Potato	Japan	WP	Foliar		0.0013-0.0002		4	3
Potato	South Africa	EC	Foliar	0.03				21
Potato	Switzerland	EC		0.015				21
Potato	USA	SC	Foliar	0.043–0.054		0.224	2	21
Potato	USA	SC	Soil incorporation	0.17-0.34		0.56 including foliar		
Radish	Israel	EC	Foliar	0.075				14
Radish, Japanese	Japan	WP			0.0013-0.002			21
Rape	Australia	EC	Foliar, 28 days before graze or feed	0.005-0.02				
Rape	Brazil	EC	Foliar	0.032			1	14
Rape	Germany (pending)	SC	Foliar	0.008-0.01			1	56
Rape	Poland (pending)	EC	Foliar	0.01				7
Rape	USA	EC, WP, GR	Foliar	0.036–0.045		0.09		35
Root and tuber veg	USA	EC WP	Foliar	0.09–0.11		0.56		21
Root and tuber veg	USA	EC	Foliar	0.037–0.11		0.56	2	21
Root and tuber veg	USA	GR	In-furrow at planting	0.009 kg /1000 m		0.45		
Root and tuber veg	USA	GR	In-furrow	0.336		0.56		
Root and tuber veg	USA	EC	In-furrow at planting, soil incorporation	0.17–0.34		0.56		21
Root and tuber veg	USA	EC	Soil incorporation	0.056–0.17		0.56		21
Sugar beet	France (pending)	SC	Foliar	0.03				35
Sugar beet	Switzerland	EC		0.015				42
Soya bean	Brazil	EC	Foliar	0.002–0.016				30
Soya bean	Brazil	EC	Seed treatment	0.09–0.12 kg /100kg of seeds				

Crop	Country	Application						
		Form	Type	Max rate kg ai/ha	Max conc kg ai/hL	Max per season kg ai/ha	Max number	PHI days
Soya bean	USA	EC	Foliar	0.037–0.11		0.34		18
Soya bean	USA	WP	Foliar	0.028–0.11		0.22		3
Soya bean	USA	WP	In furrow with the seed or transplant	0.056–0.11		0.11		3
Soya bean	USA	SC	Foliar	0.034-0,048		0.15	7	7
Soya bean	USA	GR		0.045-0.11		0.22		3 (9 if harvested by hand)
Soya bean	USA	SC	Band over open seed furrow or in-furrow with seed, broadcast to soil surface	0.045-0.11		0.11		
Strawberry	Belgium (pending)	SC	Foliar	0.04-0.05			1	3
Strawberry	France (pending)	SC	Foliar	0.012-0.04				3
Strawberry	Italy (pending)	EC, SC	Foliar		0.002-0.006		2	14
Strawberry	Italy (pending)	GR	In-furrow at seeding or at transplant	0.004-0.005				14
Strawberry	Japan	FU	Smoking	1.2 g ai/green house				1
Strawberry	Poland (pending)	EC	Foliar	0.06				14
Strawberry	Spain (pending)	EC	Foliar	0.04				3
Strawberry	UK (pending)	SC	Foliar	0.024			2	14
Strawberry	USA	WP	Foliar	0.045–0.22		0.56		
Sweet corn	France (pending)	SC	Foliar	0.012-0.03				14
Sweet corn	Italy (pending)	EC, SC	Foliar	0.02			1	7
Sweet corn	Italy (pending)	GR	In-furrow at seeding or at transplant	0.004-0.005				7
Sweet corn	USA	EC	Spraying over an open seed furrow	0.0034-0.007 kg /1000 m of row		0.11	1	30
Sweet corn	USA	EC	Soil treatment, pre-emergence	0.045-0.69		0.34		30
Sweet corn	USA	EC	Foliar	0.036–0.11		0.34		1
Sweet corn	USA	GR	In-furrow	0.003-0.01 kg /1000		0.11		

Crop	Country	Application						
		Form	Type	Max rate kg ai/ha m of row	Max conc kg ai/hL	Max per season kg ai/ha	Max number	PHI days
Sweet corn	USA	SC	At plant as band over an open furrow or in furrow with the seed.	0.045-0.11		0.11		
Sweet corn	USA	SC	Pre-plant incorporation	0.053-0.07		0.22		
Sweet corn	USA	SC	Pre-emergence	0.045		0.22		
Sweet corn	USA	GR	Foliar broadcast	0.045–0.11		0.22		1, 18 if harvested by hand
Tangerine	Italy (pending)	SC	Ground spray		0.004			21
Tangerine	Italy (pending)	EC, SC	Foliar		0.002-0.006			21
Tea	China	EC	Foliar	0.0075–0.053			1	7
Tea	China	SC	Foliar	0.018–0.036			2	
Tea	Japan	WP, SC	Foliar	0.08	0.002		2	14
Tea	Korea	WP	Foliar	0.02			3	14
Tea	Taiwan	EC	Foliar	0.014			1	12
Tomato	Australia	EC	Foliar	0.06-0.08	0.003-0.008			1
Tomato	Greece (pending)	EC, SC	Foliar		0.001-0.004		1-2	5
Tomato	Hungary (pending)	EC	Foliar	0.02-0.04				7
Tomato	Israel	EC	Foliar	0.02-0.075				7
Tomato	Italy (pending)	EC, SC	Foliar		0.002-0.004		2	7
Tomato	Italy (pending)	GR	In-furrow at seeding or at transplant	0.004-0.005				7
Tomato	Mexico	EC	Foliar	0.06				1
Tomato	Poland (pending)	EC	Foliar	0.1				2
Tomato	South Africa	EC	Foliar	0.03-0.04		0.08		5
Tomato	Spain (pending)	EC	Foliar	0.028-0.056				3
Tomato	USA	EC, WP	Foliar	0.022–0.11			4	1
Tomato	USA	WP	In-furrow at seeding or at transplant	0.056–0.09				
Tomato	USA	SC	In-furrow at seeding or at the soil surface in band over the open furrow	0.045-0.11		0.11		
Tomato	USA	SC	Broadcast over the soil	0.045-0.09		0.11		

Crop	Country	Application						
		Form	Type	Max rate kg ai/ha	Max conc kg ai/hL	Max per season kg ai/ha	Max number	PHI days
			surface					
Tomato	USA	SC	Foliar, aerial	0.022-0.84		0.27		1
Tree nuts	USA	WP	Foliar	0.056–0.22		0.56		21 pecan, 7 others
Vegetables	Poland (pending)	EC	Foliar	0.02				7
Wheat	Australia	EC	Foliar, 28 days before grazing or feeding	0.005–0.02				
Wheat	Brazil	EC	Storage	0.0004 kg/ton			1	30
Wheat	France (pending)	SC		0.008-0.01				
Wheat	Germany (pending)	SC	foliar	0.008-0.01			1	35
Wheat	Hungary (pending)	EC	Foliar	0.01				35
Wheat	Italy (pending)	EC, SC	Foliar	0.0075			1	42
Wheat	Poland (pending)	EC	Foliar	0.01				7
Wheat	Switzerland	EC		0.02				42
Wheat	UK (pending)	SC	Foliar, before BBCH 77	0.0064		0.0152		
Wheat	UK (pending)	EC, UL	Storage	0.0003 kg/ton			1/batch	

[a] Mango, okra and papaya:

Use pattern provided as part of the field trials conducted within the Pesticide Initiative Programme aiming to provide data for establishing import MRLs in the European Union. The application conditions were based on the requirement of appropriate control of diseases, but they were not supported by label or official declaration of approved use.

RESIDUES RESULTING FROM SUPERVISED TRIALS ON CROPS

The Meeting received information on supervised field trials for bifenthrin uses that produced residues on the following commodities.

Crop Group	Commodity	Table No
Citrus fruits	Lemons	37
	Oranges	38
	Grapefruit	39
Berries and other small fruits	Caneberries	40
	Strawberries	41
Assorted tropical and sub-tropical fruit – inedible peel	Banana	42

Crop Group	Commodity	Table No
	Mango	43
	Papaya	44
Brassica vegetables	Brussels sprouts	45
	Cabbage, head	46
	Cauliflower	47
Fruiting vegetables, other than Cucurbits	Egg plant	48
	Peppers	49
	Okra	50
	Sweet corn	51
	Tomato	52
Leafy vegetables	Mustard greens	53
	Radish leaves and tops	54
Legume vegetables	Beans	55
Legume vegetables	Peas	56
Pulses	Beans, dry	57
	Peas, dry	58
	Soya beans, dry	59
Root and tuber vegetables	Carrot	60
	Potato	64
	Radish	62
	Sugar beet	63
Cereal grains	Barley	64
	Maize	65
	Oat	66
	Triticale	67
	Wheat	68
	Wheat, stored grains	69
Tree nuts	Tree nuts	70
Oilseed	Cotton seed	71
	Rape seed	72
Legume animal feed	Pea hay or fodder (dry)	73
	Pea vines (green)	74
Straw, fodder and forage of cereals	Barley straw	75
	Maize straw	76
	Oat straw	77
	Triticale straw	78

Crop Group	Commodity	Table No
	Wheat straw	79
	Barley forage	80
	Maize forage	81
	Oat forage	82
	Triticale forage	83
	Wheat forage	84
Miscellaneous fodder and forage crops	Almond hulls	85
	Rape forage	86
	Sugar beet leaves or tops	87
Dried herbs	Hops, dry	88
Teas	Tea, green, black	89

Conditions of the supervised residue trials were generally well reported in detailed field reports, if not, it is indicated in the tables below. Most trial designs used replicate plots. The highest value was used for evaluation.

Laboratory reports included method validation with procedural recoveries from spiking at residue levels similar to those occurring in samples from the supervised trials. Dates of analysis or duration of residue sample storage were also provided. Residue data are recorded unadjusted for recovery.

In the tables below, undetected residues were generally reported lower than the LOQ. In some of the studies submitted, undetected residues were reported as < LOD. Residues that were detected but below the LOQ are listed in the tables below as values in parentheses. If no LOQ was provided, it is indicated in the tables.

Residues and application rates have generally been rounded to two significant figures. Residue values from the trials conducted according to maximum GAP have been used for the estimation of maximum residue levels. Those results included in the evaluation are underlined.

Citrus fruits

Table 37 Bifenthrin residues in lemon

Country, year, location	Application			PHI, days	Commodity	Residue, mg/kg	Report
	Form	kg ai/ha	No				
Brazil, 1987	EC, foliar	0.025	1	1 3 7 10	Whole fruit	< 0.05 (0.01, 0.02, 0.03) < 0.05 (0.02, 0.01, 0.01) < 0.05, < 0.05, < 0.05 < 0.05, < 0.05, < 0.05	13.3.2/2
Brazil, 1987	EC, foliar	0.038	1	1 3 7 10	Whole fruit	< 0.05 (0.04, 0.03, 0.03) < 0.05 (0.03, 0.03, 0.01) < 0.05, <u>0.05</u>, < 0.05 < 0.05, < 0.05, < 0.05	
Brazil, 1987	EC, foliar	0.05	1	1 3 7 10	Whole fruit	< 0.05 (0.03, 0.04), 0.05 < 0.05 (0.03, 0.03, 0.03) < 0.05 (0.02, 0.01, 0.02) < 0.05 (0.01, 0.01), < 0.05	
Brazil, 1987	EC, foliar	0.075	1	1 3 7 10	Whole fruit	0.06, 0.05, 0.06 < 0.05 (0.04, 0.04), 0.05 < 0.05 (0.03, 0.02), 0.02 < 0.05 (0.02, 0.01), 0.01	
Brazil, 1987	EC,	0.10	1	1	Whole fruit	0.10, 0.09, 0.13	

Country, year, location	Application			PHI, days	Commodity	Residue, mg/kg	Report
	Form	kg ai/ha	No				
	foliar			3 7 10		0.07, 0.05, 0.05 < 0.05 (0.03, 0.04, 0.04) < 0.05 (0.02, 0.03, 0.01)	
Spain, 1986	EC, foliar	0.075	1	31	Pulp Peel	< 0.05, < 0.05, < 0.05, < 0.05 0.08, 0.08, 0.08, 0.09	FCC 110
Spain, 1989	EC, foliar	0.030	1	0 4 14 20	Whole fruit	< 0.05 (0.01) 0.08 0.09 0.06	13.3.2/5
USA, CA, 1990	WP, foliar	0.11	2	76	Whole fruit	< 0.05, < 0.05, < 0.05, < 0.05	P-2590
USA, AZ, 1990	WP, foliar	0.11	2	81	Whole fruit	< 0.05 (0.01), < 0.05 (0.01), < 0.05, < 0.05	
USA, FL, 1999	WP, soil	0.56	1	1	Whole fruit	< 0.05, < 0.05	P-3460
USA, FL, 1999	EC, soil	0.56	1	1	Whole fruit	< 0.05, < 0.05	
USA, AZ,1999 Hyder	WP, soil	0.57	1	1	Whole fruit	< 0.05, < 0.05	
USA, AZ, 1999 Waddell	WP, soil	0.56	1	1	Whole fruit	< 0.05, < 0.05	
USA, CA, 1999 Terra Bella	WP, soil	0.56	1	1	Whole fruit	< 0.05, < 0.05	
USA, CA, 1999 Reedley,	WP, soil	0.56	1	1	Whole fruit	< 0.05, < 0.05	
USA, CA, 1999 Redley	EC, Soil	0.56	1	1	Whole fruit	< 0.05, < 0.05	

Table 38 Bifenthrin residues in orange.

Country, Year, location	Application			PHI, days	Commodity	Residue, mg/kg	Report
	Form	kg ai/ha	No				
Brazil, 1986	EC, foliar	0.025	1	1 3 7 10	Whole fruit	< 0.05 (0.02, 0.03, 0.03) < 0.05, < 0.05, < 0.05 < 0.05, < 0.05, < 0.05 < 0.05, < 0.05, < 0.015	13.3.2/3
Brazil, 1986	EC, foliar	0.038	1	1 3 7 10	Whole fruit	< 0.05 (0.04, 0.04) 0.05 < 0.05, < 0.05, < 0.05 < 0.05, < 0.05, < 0.05 < 0.05, < 0.05, < 0.05	13.3.2/3
Brazil, 1986	EC, foliar	0.050	1	1 3 7 10	Whole fruit	0.06, 0.05, < 0.05 (0.04) < 0.05 (0.03, 0.03, 0.02) < 0.05, < 0.05, < 0.05 < 0.05, < 0.05, < 0.05	13.3.2/3
Brazil, 1986	EC, foliar	0.075	1	1 3 7 10	Whole fruit	0.08, 0.08, 0.08 < 0.05 (0.04), 0.05, 0.05 < 0.05 (0.04, 0.03, 0.03) < 0.05 (0.02, 0.01, 0.02)	13.3.2/3
Brazil, 1986	EC, foliar	0.10	1	1 3 7 10	Whole fruit	0.15, 0.12, 0.10 0.08, 0.07, 0.07 < 0.05 (0.03), 0.05, 0.05 < 0.05 (0.03, 0.04, 0.03)	13.3.2/3
Italy, 2001	EC, foliar	0.061	1	21	Whole fruit	0.049	FMC/BIF/01021

Country, Year, location	Application Form	kg ai/ha	No	PHI, days	Commodity	Residue, mg/kg	Report
	0.004 kgai/hL						LOQ 0.02 mg/kg
Italy, 2001	EC, foliar 0.004 kgai/hL	0.038	1	21	Whole fruit	0.025	
Italy, 2001	EC, foliar 0.004 kgai/hL	0.060	1	21	Whole fruit	0.059	
Italy, 2001	EC, foliar 0.004 kgai/hL	0.049	1	20	Whole fruit	0.078	
Spain, 1989	EC, foliar	0.020	3	0 3 7 15 25	Whole fruit	< 0.05 (0.02) < 0.05 < 0.05 < 0.05 (0.04) < 0.05	13.3.2/4
Spain, 1989	EC, foliar	0.0075	3	0 3 7 15 25	Whole fruit	0.07 0.05 < 0.05 (0.01) < 0.05 < 0.05	
Spain, 2001 Castillana	EC, foliar 0.004 kgai/hL	0.15	1	7 21	Whole fruit	0.081 0.062	FMC/BIF/01021 LOQ 0.02 mg/kg
Spain, 2001 Benacazon	EC, foliar 0.004 kgai/hL	0.11	1	7 21	Whole fruit	0.066 0.056	
Spain, 2001 Lepe	EC, foliar 0.004 kgai/hL	0.11	1	7 21	Whole fruit	0.070 0.038	
Spain, 2001 Almonte	EC, foliar 0.004 kgai/hL	0.12	1	7 21	Whole fruit	0.065 < 0.02	
USA, CA, 1990, Navelencia	WP, foliar	0.11	2	128	Whole fruit Pulp Peel	< 0.05 (0.02, 0.01) < 0.05, < 0.05 < 0.05 (0.03, 0.03)	P-2591
USA, CA, 1990, Ivanhoe	WP, foliar	0.11	2	128	Whole fruit Pulp Peel	< 0.05 (0.03, 0.03) < 0.05, < 0.05 0.19, 0.16	
USA, AZ, 1990	WP, foliar	0.11	2	128	Whole fruit	< 0.05 (0.01), < 0.05	
USA, CA, 1990, El Centro	WP, foliar	0.11	2	146	Whole fruit	< 0.05, < 0.05	
USA, FL, 1995 La Belle	WP, soil	0.28	2	1	Whole fruit	< 0.05, < 0.05	P-3142
USA, FL, 1995 Alva	WP, soil	0.28	2	1	Whole fruit	< 0.05, < 0.05	
USA, FL, 1995 La Belle	WP, soil	0.56	1	1	Whole fruit	< 0.05, < 0.05	P-3134
	WP, soil	0.56	1	1	Whole fruit	< 0.05, < 0.05	
USA, FL, 1997 Indiantown	WP, soil	0.56	1	1	Whole fruit	0.0063, 0.0082	RAN-0313
USA, FL, 1997 La Belle	WP, soil	0.56	1	1	Whole fruit	< 0.005, < 0.005	LOQ 0.005 mg/kg
USA, FL, 1997	WP, soil	2.80	1	1	Whole fruit	< 0.05, < 0.05	P-3395
USA, FL, 1998 DeLeon	WP, soil	0.56	1	1	Whole fruit	< 0.05, < 0.05	P-3377
USA, FL, 1998 Sanford	WP, soil	0.56	1	1	Whole fruit	< 0.05, < 0.05	
USA, FL, 1998 Christmas	WP, soil	0.56	1	1	Whole fruit	< 0.05, < 0.05	
USA, FL, 1998 St Cloud	WP, soil	0.56	1	1	Whole fruit	< 0.05, < 0.05	

Country, Year, location	Application			PHI, days	Commodity	Residue, mg/kg	Report
	Form	kg ai/ha	No				
USA, FL, 1998 DeLeon	WP, soil	0.56	1	1	Whole fruit	≤ 0.05, < 0.05	
USA, FL, 1998 Sanford	WP, soil	0.56	1	1	Whole fruit	≤ 0.05, < 0.05	
USA, FL, 1998 Chuluota	WP, soil	0.56	1	1	Whole fruit	≤ 0.05, < 0.05	
USA, FL, 1998 St Cloud	WP, soil	0.56	1	1	Whole fruit	≤ 0.05, < 0.05	
USA, FL, 1998 Umatilla	WP, soil	0.56	1	1	Whole fruit	≤ 0.05, < 0.05	
USA, TX, 1998	WP, soil	0.56	1	1	Whole fruit	≤ 0.05, < 0.05	
USA, CA, 1998 Fresno	WP, soil	0.56	1	1	Whole fruit	≤ 0.05, < 0.05	
USA, CA, 1998 Reedley	WP, soil	0.56	1	1	Whole fruit	≤ 0.05, < 0.05	
USA, CA, 1998 Terra Bella	WP, soil	0.56	1	1	Whole fruit	≤ 0.05, < 0.05	
USA, AZ, 1998	WP, soil	0.56	1	1	Whole fruit	≤ 0.05, < 0.05	
USA, FL, 1999	WP, soil	0.56	1	1	Whole fruit	≤ 0.05, < 0.05	P-3459
USA, FL, 1999	EC, soil	0.56	1	1	Whole fruit	≤ 0.05, < 0.05	
USA, CA, 1999	WP, soil	0.56	1	1	Whole fruit	≤ 0.05, < 0.05	
USA, FL, 1999	EC, soil	0.56	1	1	Whole fruit	≤ 0.05, < 0.05	

Table 39 Bifenthrin residues in grapefruit

Country, year, location	Application			PHI, days	Commodity	Residue, mg/kg	Report
	Form	kg ai/ha	No				
USA, AZ, 1990, Yuma	WP, foliar	0.11	2	146	Whole fruit	< 0.05 (4)	P-2589
USA, FL, 1999 DeLeon, treated 06-Apr-99	WP, soil	0.56	1	1	Whole fruit	≤ 0.05, < 0.05	P-3457
USA, FL, 1999 DeLeon	EC, soil	0.56	1	1	Whole fruit	≤ 0.05, < 0.05	
USA, FL, 1999 Mt.Dora	WP, soil	0.56	1	1	Whole fruit	≤ 0.05, < 0.05	
USA, FL, 1999 DeLeon, treated 30-Nov-99	WP, soil	0.56	1	1	Whole fruit	≤ 0.05, < 0.05	
USA, TX, 1999 Raymondville	WP, soil	0.55	1	1	Whole fruit	≤ 0.05, < 0.05	
USA, CA, 1999 Visalia	WP, soil	0.56	1	1	Whole fruit	≤ 0.05, < 0.05	
USA, CA, 1999 Terra Bella	WP, soil	0.56	1	1	Whole fruit	≤ 0.05, < 0.05	
USA, CA, 1999, Terra Bella	EC, soil	0.56	1	1	Whole fruit	≤ 0.05, < 0.05	

Berries and other small fruits

Table 40 Bifenthrin residues in caneberry

Country, year, location	Application				PHI, days	Berries	Residue, mg/kg	Report
	Form	kg ai/ha	kg ai/hL	No				
USA, MI, 1995	WP	0.11	0.01	2	3	Raspberry	≤ 0.05, < 0.05	IR-4 PR No 05004
USA, NH, 1995	WP	0.11	0.05	2	3	Raspberry	0.23, 0.29	
USA, OR, 1995	WP	0.11	0.02	2	3	Raspberry	0.20, 0.25	
USA, OR, 1997	WP	0.11	0.03	2	3	Raspberry	0.22, 0.34	

Country, year, location	Application				PHI, days	Berries	Residue, mg/kg	Report
	Form	kg ai/ha	kg ai/hL	No				
USA, OR, 1997	WP	0.11	0.03	2	3	Blackberry	0.43, 0.51	

Table 41 Bifenthrin residues in strawberries

Country, year, location	Application				PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	kg ai/hL	No			
Belgium, 1985 Wilderen	EC	0.04		1	0 3 7 14 21	0.18, 0.20, 0.11, 0.16 0.16, 0.17, 0.04, 0.06 0.11, 0.10, 0.07, 0.05 0.06, 0.05, 0.05, 0.05 0.05, < 0.05 (0.02, 0.04, 0.04)	RES 85/16
Belgium, 1985 Wilderen	EC	0.075		1	0 3 7 14 21	0.35, 0.46, 0.23, 0.35 0.21, 0.29, 0.18, 0.22 0.22, 0.13, 0.14, 0.20 0.08, 0.16, 0.06, 0.11 0.08, 0.06, < 0.05 (0.04), 0.06	RES 85/16
France, 1988		0.04		1	0 1 3	< 0.015, < 0.015 < 0.015 < 0.015, < 0.015	881113
France, 2000 Cendrieux	EC	0.042		2	3	0.06,< 0.05	FA-17-00-78
	EC	0.039		2	3	< 0.05, < 0.05	
France, 2000 St. Lambert	EC	0.041		2	3	0.09	FA-17-00-79
France, 2000 Laventie	EC	0.042		2	3	0.10	
Italy, 2000 Pergine	EC	0.038		2	3	0.07	FA-17-00-77
Italy, 2000 Canezza	EC	0.040		2	3	< 0.05	
Netherlands, 2000 De Mortel	EC	0.040		1	3	< 0.05	FA-17-00-76
Netherlands, 2000 Voerendaal	EC	0.040		1	3	0.10	
Poland, 1986	EC	0.078		1	32 35 38 42 46	0.01 0.005 0.003 0.003 0.003	FMC Pol-1986 Method: No information provided
Spain, 1986 Selent Treated 25-Feb-86	EC	0.12		1	0 3 6	0.41 0.45 0.25	13.2.3/3
Spain, 1986 V. de Castello Treated 04-Apr-86	EC	0.14		1	0 3 5	0.52 0.33 0.40	
Spain, 1986 V. de Castello Treated 21-Apr-86	EC	0.095		1	0 3 5	1.15 0.80 0.47	
Spain, 1989 Huelva Treated 14-Mar-89	EC	0.12		1	0 3 7 14	0.96, 1.34, 0.76, 0.96 0.53, 0.86, 0.28, 0.28 0.28, 0.55, 0.45, 0.72 0.33, 0.26, 0.19, 0.33	BI 13.2.3/7 LOQ 0.01 mg/kg, no other method information reported
Spain, 1989 Huelva Treated 15-Mar-89	EC	0.12		1	0 3 7 14	0.28, 0.40, 0.24, 0.74 0.26, 0.19, 0.10, 0.15 0.25, 0.13, 0.08, 0.20 0.05, 0.09, 0.02, 010	
UK, 1987, Malling	EC	0.05		1	0 7	< 0.01, < 0.01 0.01, 0.04	73/79
UK, 1987, Tayside	EC	0.05		1	0 3 7	0.02, 0.02, 0.01 0.04, 0.02, 0.02 0.03, 0.01, < 0.01	LOQ 0.01 mg/kg

Country, year, location	Application				PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	kg ai/hL	No			
UK, 1990, Southwell	EC		0.004[a]	1	0 3 7 14	0.27, 0.28, 0.30 0.27 0.18 0.11	AS/1355/MO/2 FC-0190
UK, 1990, Southwell	EC		0.008[a]	1	0 3 7 14	0.44, 0.52, 0.71 0.42 0.30 0.18	
UK, 1990, Southwell	ME		0.004[a]	1	0 3 7 14	0.17, 0.19, 0.17 0.21 0.11 0.07	
UK, 1990, Southwell	ME		0.008[a]	1	0 3 7 14	0.35, 0.31, 0.32 0.34 0.22 0.13	
UK, 1992	ME	0.08[a]		1	0 3 8 14	0.20, 0.24, 0.27 0.11 0.13 0.05	FCC 0392
UK, 1992	TB	0.04[a]		1	0 3 8 14	0.10, 0.12, 0.90 0.06 0.04 0.05	
UK, 1993, Ledbury	EC	0.04		2	3	0.03, 0.05, 0.06	FCC 0593
UK, 1993, Ross on Wye	EC	0.04		2	3	0.03, 0.03, 0.03	
UK, 1995, Southwell, treated 28-Jul-95	EC	0.054[a]		3	0 3	0.25 0.18	AK/2960/FM
UK, 1995, Southwell, Treated 03-Aug-95	EC	0.07[a]		3	0 3	0.38 0.32	
UK, 1995, Oundle, treated 31-Jul-95	EC	0.056[a]		3	0 3	0.15 0.18	
UK, 1996, Southwell, 01-Jul-96	EC	0.058[a]		3	0 3	0.09 0.07	
UK, 1996, Maidstone, treated 28-Jun-96	EC	0.056[a]		3	0 3	0.14 0.10	
UK, 1996, Ledbury, treated 02.Jul-96	EC	0.057[a]		3	0 3	0.06 0.07	
UK, 1995, Southwell, treated 28-Jun-95	EC	0.058[a]		3	0	0.21	
UK, 1995, Southwell, treated 03-Aug-95	EC	0.059[a]		3	0	0.29	
UK, 1996, Oundle, treated 31-Jul-96	EC	0.063[a]		3	0	0.15	
UK, 1996, Southwell, treated 01-Jun-96	EC	0.046[a]		3	0	0.08	
UK, 1996, Maidstone, teated 28-Jun-96	EC	0.057[a]		3	0	0.12	
UK, 1996, Ledbury, treated 02-Jul-96	EC	0.057[a]		3	0	0.07	
USA, CA, 1984, Watsonville Treated 13-Jun-84	EC	0.11		4	0 1 2 3 5	0.21, 0.22 0.27, 0.24 0.23, 0.24 0.20, 0.20 0.21, 0.20	P-0944

Country, year, location	Application				PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	kg ai/hL	No			
USA, CA, 1984, Oxnard	EC	0.11		4	0 1 3	0.36, 0.32 0.31, 0.29 0.26, 0.26	
USA, CA, 1984, Watsonville Treated 09-Sep-83	EC	0.11		4	0 1 3	0.35, 0.42 0.37, 0.29 0.33, 0.29	
USA, CA, 1984, Watsonville Treated 10-Jul-84	EC	0.11		4	0 1 3	0.18, 0.17 0.14, 0.15 0.11, 0.15	
USA, CA, 1984, Orange County	WP	0.22		4	0 1 3	< 0.1 (0.07), 0.48 0.23, 0.47 0.11, 0.46	P-1073
USA, IN, 1984, Evansville	WP	0.22		4	0 1 3	0.19, 0.29 0.24, 0.17 0.24, 0.33	
USA, CA, 1984, Oxnard	WP	0.22		2	0 1 3	0.59, 0.41 0.32, 0.33 0.48, 0.28	
USA, PN, 1984, Mechanicsburg	WP	0.22		4	0 1 3	0.29, 0.16 0.33, 0.26 0.20, 0.12	
USA, OR, 1984, Cornelius	WP	0.22		4	0 1 3 5	0.28, 0.30 0.35, 0.28 0.31, 0.41 < 0.1	
USA, CA, 1984, Watsonville	WP	0.22		4	0 1 3	0.30, 0.34 0.24, 0.12 0.20, 0.23	
USA, FL, 1984, Dover	WP	0.22		4	0 1 3	0.75, 0.88 0.56, 0.43 0.45, 0.42	
USA, NY, 1984, Phelps	WP	0.22		4	0 1 3 6	0.46, 0.40 0.35, 0.30 0.22, 0.27 < 0.1 (0.06)	
USA, MI, 1984, Fennville	WP	0.22		4	0 1 3 4	0.31, 0.29 0.34, 0.32 0.27, 0.20 < 0.1	
USA, CA, 1987, Salinas	WP	0.22		4	0 1 3 5	0.46, 0.86 0.29, 0.43 0.29, 0.31 0.14, 0.21	PC-0127
USA, CA, 1987, Santa Maria	WP	0.22		4	0 1 3 5	0.13, 0.054 0.077, 0.11 0.51, 0.44 0.16, 0.27	
USA, LS, 1988, Hammond	WP	0.22		4	0 1 3 5	0.34, 0.34 0.29, 0.36 0.30, 0.29 0.30, 0.23	
USA, FL, 1988, Groveland	WP	0.22		4	0 1 3 5	1.4, 2.3 0.86, 1.4 0.81, 0.92 0.56, 0.64	
USA, FL, 1988, Dover	WP	0.22		4	0 1 3	1.8, 1.0 1.5, 2.1 1.6, 1.7	

Country, year, location	Application				PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	kg ai/hL	No			
					5	1.1, 1.2	
USA, OR, 1990	EC	0.22		4	0 1 3	0.34, 0.46 0.34, 0.24 0.29, 0.30	P-2607
USA, ON, 1990	EC	0.22		4	0 1 3	0.26, 0.24 0.22, 0.23 0.31, 0.12	
USA, LS, 1990	WP	0.22		4	0 1 3	0.75, 0.86 0.76, 0.75 0.65, 0.58	
USA, CA, 1990, Santa Maria, treated 09-Oct-90	WP	0.22		4	0 1 3	0.15, 0.27 < 0.05 (0.01), 0.13, 0.14 0.22, 0.16	
USA, CA, 1990, Santa Maria, Treated 22-Oct-90	WP	0.22		4	0 1 3	0.24, 0.30 0.26, 0.09 0.07, 0.15	

[a] Applied to the point of runoff

Assorted tropical and sub-tropical fruit – inedible peel

Table 42 Bifenthrin residues in banana. Fruit development within bags impregnated with 0.1% bifenthrin

Country, year, location	Appl % ai	Days [a]	Residues, mg/kg			Report
			Peel	Pulp	Whole fruit	
France (Martinique), 1997	0.1	77	0.05, < 0.05	< 0.01, < 0.01		P-3437
France (Martinique), 1998 Treated 05-Feb.98	0.1	1	< 0.05, < 0.05	< 0.01, < 0.01		
		14	< 0.05, < 0.05	< 0.01, < 0.01		
		28	0.10, 0.11	< 0.01, < 0.01		
		56	0.07, 0.08	< 0.01, < 0.01		
		81	0.06, 0.09	< 0.01, < 0.01		
France (Martinique), 1998 Treated 06-Mar-98	0.1	4	0.12, 0.08[b]	< 0.01, < 0.01		
		24	0.09, 0.09[c]	< 0.01, < 0.01		
		73	0.05, 0.06	< 0.01, < 0.01		
Spain (Canary Islands), 1998	0.1	1	< 0.05, < 0.05	< 0.01, < 0.01		
		29	0.08, 0.06	< 0.01, < 0.01		
		57	0.05, < 0.05	< 0.01, < 0.01		
		113	0.08, 0.08	< 0.01, < 0.01		
		132	< 0.05, 0.08	< 0.01, < 0.01		
France (Martinique), 1999	0.1	70	0.11, 0.11	< 0.01, < 0.01		BKA/631/98/RES
Spain (Canary Islands), 1999	0.1	104	0.08, 0.06	< 0.01, < 0.01		
Puerto Rico, 1997	0.1	75	0.068, 0.057	< 0.01, < 0.01	< 0.05 (0.031), < 0.05 (0.026)	P-3426
Puerto Rico, 1998	0.1	63	0.059, 0.058	< 0.01, < 0.01	< 0.05 (0.035), < 0.05 (0.033)	
	0.1	77	0.059, 0.055	< 0.01, < 0.01	< 0.05 (0.032), < 0.05 (0.029)	
	0.1	91	0.062, 0.061	< 0.01, < 0.01	< 0.05 (0.029), < 0.05 (0.027)	
	0.1	105	< 0.05 (0.042), < 0.05 (0.041)	< 0.01, < 0.01	< 0.05 (0.018), < 0.05 (0.018)	
	0.1	112	< 0.05 (0.044), 0.055	< 0.01, < 0.01	< 0.05 (0.018), < 0.05 (0.024)	
USA, HI, 1997	0.1	91	0.13, 0.15	< 0.01, < 0.01	< 0.05 (0.048), 0.057	
USA, FL, 1997 Treated 13-Aug-97	0.1	43	0.12, 0.14	< 0.01, < 0.01	0.062, 0.074	
USA, FL, 1997	0.1	43	0.15, 0.15	< 0.01, < 0.01	< 0.05 (0.031),	

Country, year, location	Appl % ai	Days [a]	Residues, mg/kg			Report
			Peel	Pulp	Whole fruit	
Treated 14-Aug-97					< 0.05 (0.027)	

[a] Time between placement of the bags and harvest of the bananas.

[b] Bag was replaced 1 week prior to harvest.

[c] Bag was replaced 4 weeks prior to harvest.

Table 43 Bifenthrin residues in mango.

Country, year, location	Application			PHI, days	Commodity	Residue, mg/kg	Report
	Form	kg ai/ha	No				
Senegal, 2004	EC	0.05	1	1 4 7 7 7 14 14 14 21	Whole fruit Whole fruit Peel Flesh Whole fruit Peel Flesh Whole fruit Whole fruit	0.31 0.12 1.4 < 0.01 0.13 1.9 < 0.01 0.07 0.13	SE/CERES/MA/2004/1 Analysis PIP-051
Mali, 2004	EC	0.05	1	1 4 7 7 7 14 14 14 21	Whole fruit Whole fruit Peel Flesh Whole fruit Peel Flesh Whole fruit Whole fruit	0.053 0.077 0.52 < 0.01 0.23 0.90 < 0.01 0.18 0.011	MLI/IER/MA/2004/2 Analysis A4168-1
Mali, 2005, Baguinida	EC	0.05	1	1 4 7 14 21	Whole fruit	0.14 0.16 0.15 0.044 0.046	MLI/IER/MA/2005/1 Analysis PIP-0503
Mali, 2005, Sikasso	EC	0.05	1	1 4 7 14 21	Whole fruit	0.079 0.068 0.066 0.036 0.046	MLI/IER/MA/2005/1 Analysis PIP-0503

Table 44 Bifenthrin residues in papaya, whole fruit

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
Ghana, 2005 Dansak Season 1	EC	0.05	2	3	0.12	GHA/PA/2005/01 Analysis PGD-221
	EC	0.05	4	0 3 7 14 28	0.27 0.20 0.17 0.11 0.11	
Ghana, 2005 Golden Exotics Season 1	EC	0.05	2	3	0.17	GHA/PA/2005/02 Analysis PGD-221
	EC	0.05	4	0 3 7 14 28	0.20 0.14 0.11 0.13 0.075	

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
Ghana, 2006 Dansak Season 2	EC	0.05	2	3	0.17	GHA/PA/2005/03 Analysis PGD-231
	EC	0.05	4	0 3 7 14 28	0.17 0.11 0.12 <u>0.16</u> 0.088	
Ghana, 2006 Golden Exotics Season 2	EC	0.05	2	3	0.18	GHA/PA/2005/04 Analysis PGD-231
	EC	0.05	4	0 3 7 14 28	0.20 <u>0.13</u> 0.065 0.095 0.075	
Ivory Cost, 2004, Tiessale Combination 1	EC	0.05	1	3 7	< 0.05 < 0.05	CIV/CNRA/PA/2004 Analysis PGD-168
			2	3 7	0.057 < 0.05	
			3	3 7	0.16 0.17	
			4	3 7	<u>0.30</u> 0.28	
Ivory Cost, 2004, Tiessale Combination 3	EC	0.05	1	3 7	< 0.05 < 0.05	CIV/CNRA/PA/2004 Analysis PGD-170
			2	3 7	< 0.05 < 0.05	
			3	3 7	< 0.05 < 0.05	
			4	3 7	<u>0.095</u> 0.057	
Ivory Cost, 2003, Azaguie Combination 1	EC	0.05	1	3 7	< 0.05 < 0.05	CIV/CNRA/PA/2004 Analysis PGD-168
			2	3 7	< 0.05 < 0.05	
			3	3 7	0.065 0.08	
			4	3 7	<u>0.17</u> 0.09	
Ivory Cost, 2003, Azaguie Combination 3	EC	0.05	1	3 7	< 0.05 < 0.05	CIV/CNRA/PA/2004 Analysis PGD-170
			2	3 7	< 0.05 < 0.05	
			3	3 7	0.079 0.10	
			4	3 7	0.10 <u>0.13</u>	

Brassica vegetables

Table 45 Bifenthrin residues in Brussels sprouts

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
Switzerland, 1985	EC	0.030	1	22	0.28	6123-85149
UK, 1985 Essex	EC	0.008	3	50	0.01, < 0.01	73/49
UK, 1985 Bedford Shire	EC	0.008	3	54	< 0.01, < 0.01	
UK, 1989 Derby	EC Talstar	0.010	3	0	0.017, 0.012, 0.014	FCC 0189
				1	0.014	
				4	0.014	

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
UK, 1989 Derby	EC Brigade	0.010	3	0 1 4	0.016, 0.012, 0.013 0.019 0.013	
UK, 1995, Melbourne	EC	0.23	3	0 3	0.24 0.26	AS/2967/FM
	EW	0.23	3	0	0.58	
	TB	0.20	3	0	0.28	
UK, 1995 Stourport	EC	0.19	3	0 3	0.65 0.64	
	EW	0.20	3	0	0.82	
	TB	0.16	3	0	0.43	
UK, 1995 Bicker	EC	0.14	3	0 3	0.36 0.54	
	EW	0.16	3	0	0.79	
	TB	0.14	3	0	0.56	
UK, 1995 Newbold	EC	0.21	3	0 3	0.45 0.61	
	EW	0.21	3	0	0.68	
	TB	0.19	3	0	0.36	
UK, 1995 Shepshed	EC	0.18	3	0 3	0.16 0.14	
	EW	0.16	3	0	0.20	
	TB	0.15	3	0	0.07	
UK, 1995 Kings Newton	EC	0.18	3	0 3	0.41 0.31	
	EW	0.22	3	0	0.42	
	TB	0.17	3	0	0.28	
France, 2003	SC	0.02	3 5	14 14	0.02 0.02	20031174/E1-FPBS
Germany, 2003	SC	0.02	3	0 1 3 7 14	0.01 0.01 0.01 < 0.01(0.007) < 0.01(0.007)	
			5	0 1 3 7 14	0.01 0.01 < 0.01 (0.009) < 0.01 (0.009) < 0.01 (0.007)	
UK, 2003	SC	0.02	3	0 1 3 7 14	0.02 0.02 0.01 0.01 < 0.01 (0.008)	
			5	0 1 3 7 14	0.05 0.04 0.04 0.03 0.03	
Netherlands, 2003	SC	0.02	3 5	14 14	< 0.01 (0.005) 0.01	
Northern France, 2004	SC	0.02	5	0 1 3 7 14	0.15 0.12 0.17 0.14 0.07	20041181/E1-FPBS
Germany, 2004	SC	0.02	5	14	0.014	
UK, 2004	SC	0.02	5	14	0.068	
Netherlands, 2004	SC	0.02	5	0 1 3 7 15	0.016 0.020 0.015 0.014 < 0.01	

Table 46 Bifenthrin residues in cabbage, Head

Country, year, location	Application				PHI, days	Residue, mg/kg		Report
	Form	kg ai/ha	kg ai/hL	No				
France, 1987	EC	0.02		1	0 14	0.22, 0.27 0.06, 0.01		73/80
France, 1994 Saint Aubin	SC	0.02		3	7	0.02		RCHOU494-02
France, 1994 Pas-de Calais	SC	0.02		3	7	< 0.01		
France, 1997 Fessenheim	SC	0.02		3	7	< 0.05		P-3331
France, 1997 Ploudalmezeau	SC	0.02		3	8	0.09		
France, 1997 Brindas	SC	0.02		3	7	< 0.05		P-3342
France, 1998 Handschuheim	SC	0.02		3	0 1 3 7 14	< 0.05 < 0.05 < 0.05 < 0.05 < 0.05		R 8181 DE
France, 1998 Osthoffen	SC	0.02		3	0 1 3 7 14	< 0.05 < 0.05 < 0.05 < 0.05 < 0.05		
France, 1999 St Coulomb Treated 11-Oct-99	SC	0.02		3	7 14	< 0.05 < 0.05		99-543
France, 1999 St Coulomb Treated 30-Nov-99	SC	0.02		3	7 14	0.18 0.13		
Italy, 1997	SC	0.03		1	7	< 0.05		P-3350
Japan, 1985 Treated 23-Oct-85	WP	0.04		4	7 14 21	0.022[1] 0.016 0.010	0.18[2] 0.10 0.083	BI 13.2.4/8 Information on collection or storage of samples not available
Japan, 1985 Treated 11-Jul-85	WP	0.013, 0.01, 0.023, 0.035		4	7 14 21	0.61[a] 0.23 0.002	0.60[b] 0.14 < 0.005	
Poland, 1985	EC	0.02		1	1 4 6	0.08 < 0.01 (LOD) < 0.01 (LOD)		FMC Pol-1986, No information on LOQ, on collection or storage of samples
				2	51	< 0.01, < 0.01 (LOD)		
UK, 1989 Chellaston	EC	0.02		3	0 1 4	0.10, 0.09 0.06 0.03		FCC 0189
UK, 1989 Kings Newton	EC	0.02		3	0 1 4	0.09 0.10 0.07		
UK, 1990 Chelleston	EC		0.002	1	0 3 7 14	0.22, 0.25, 0.18 0.23 0.18 0.04		AS/1355/MO/1 FC 0190
UK, 1990 Chelleston	EC		0.004	1	0 3 7 14	0.45, 0.36, 0.27 0.59 0.26 0.10		
UK, 1990 Chelleston	ME		0.002	1	0 3 7	0.30, 0.25, 0.21 0.22 0.18		

Country, year, location	Application				PHI, days	Residue, mg/kg		Report
	Form	kg ai/ha	kg ai/hL	No				
					14	0.09		
UK, 1990 Chelleston	ME		0.004	1	0 3 7 14	0.23, 0.31, 0.55 0.34 0.41 < 0.01		
UK, 1995, Melbourne	EC	0.20		3	0 3	0.25 0.17		AS/2967/FM
UK, 1995, Stourport	EC	0.16		3	0 3	1.5 0.97		
UK, 1995, Bicker	EC	0.12		3	0 3	0.77 0.64		
UK, 1996, Melbourne	EC	0.22		3	0 3	0.49 0.13		
UK, 1996, Stourport	EC	0.13		3	0 3	0.13 < 0.05(0.03)		
UK, 1996, Kings Newton	EC	0.062		3	0 3	0.07 < 0.05(0.03)		
UK, 1995, Melbourne	EW	0.18		3	0	0.33		
UK, 1995, Stourport	EW	0.16		3	0	1.6		
UK, 1995, Bicker	EW	0.128		3	0	1.0		
UK, 1996 Melbourne	EW	0.21		3	0	0.46		
UK, 1996, Stourport	EW	0.11		3	0	0.14		
UK, 1996 Kings Newton	EW	0.062		3	0	0.04		
UK, 1995, Melbourne	TB	0.18		3	0	0.11		
UK, 1995, Stourport	TB	0.13		3	0	0.75		
UK, 1995, Bicker	TB	0.099		3	0	0.27		
UK, 1995, Melbourne	TB	0.18		3	0	0.29		
UK, 1995, Stourport	TB	0.11		3	0	0.20		
UK, 1995, Bicker	TB	0.050		3	0	0.04		
						With wrapper leaves	Without wrapper leaves	IR-4 PR No. 05176
USA, GA, 1993	EC	0.11		11	7 20	1.5 2.3	0.19 < 0.05	
USA, SC, 1992	EC	0.20		5	7 19	7.2 1.2	0.11 < 0.05	
USA, TX, 1993	EC	0.11		5	7 20	3.1 1.5	≤ 0.05 < 0.05	
USA, CA, 1993	EC	0.11		5	6	1.5, 1.5	≤ 0.04, < 0.04	
USA, NY, 1993	EC	0.03		5	7	< 0.04, < 0.04	< 0.04, < 0.04	
USA, OH, 1993	EC	0.11		8	7	0.73, 0.82	≤ 0.04, < 0.04	
USA, WI, 1993	EC	0.11		5	7	0.44, 0.70	≤ 0.04, < 0.04	

[a] Analysis: IET

[b] Analysis: Nissan Chemical Industry Co.

Table 47 Bifenthrin residues in cauliflower

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
France, 1997	SC	0.02	3	7	< 0.05	P-3334
France, 1998 Dorlisheim	SC	0.02	3	7	< 0.05	R-8179 DE
France, 1998 Rosheim	SC	0.02	3	0 1 3 7 14	0.12 0.23 0.24 0.15 < 0.05	
France, 1998 St. Sylvain	SC	0.02	3	7	< 0.05	
France, 1998 Ploudalmezeau Variety Belot	SC	0.02	3	7	< 0.05	
France, 1998 Ploudalmezeau Variety Pierrot	SC	0.02	3	7	< 0.05	
France, 1998 Ploudalmezeau Variety Neven	SC	0.02	3	0 1 3 7 14	< 0.05 < 0.05 < 0.05 < 0.05 < 0.05	
France, 1998 Saint Coulomb Variety Nominoe	SC	0.02	3	6	< 0.05	99-503
France, 1998 Saint Malo Variety Paradiso	SC	0.02	3	6	< 0.05	
France, 2001 Aubers Variety Cortes	SC	0.02	3	8	< 0.02	BKA/692/01 /RES
France, 2001 Clere Sur Layon Variety Nautilis	SC	0.02	3	7	< 0.02	
Germany, 2008	SC	0.011	2	7 14	< 0.01 < 0.01	S08 02601
UK, 2009	SC	0.01	2	0 3 7 10 14	< 0.01 < 0.01 < 0.01 < 0.01 < 0.01	
Italy, 1997	SC	0.03	1	7	< 0.05	P-3354
Italy, 2000	SC	0.02	3	7	< 0.05	SIP 1280
UK, 1989 Chellaston	EC	0.01	3	0 1 4	0.06 0.55 0.47	FCC 0189
UK, 1989 Newton	EC	0.01	3	0 1 4	0.06 0.05 0.05	
UK, 1995 Melbourne	EC	0.12	3	0 3	0.16 0.13	AS/2967/FM
UK, 1995 Stourport	EC	0.11	3	0 3	0.20 0.13	
UK, 1995 Bicker	EC	0.21	3	0 3	< 0.05 < 0.05	
UK, 1995 Melbourne	EW	0.11	3	0	0.16	
UK, 1995 Stourport	EW	0.17	3	0	0.21	
UK, 1995 Bicker	EW	0.10	3	0	< 0.05	
UK, 1995 Melbourne	TB	0.12	3	0	0.24	

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
UK, 1995 Stourport	TB	0.10	3	0	0.19	
UK, 1995 Bicker	TB	0.093	3	0	< 0.05	
USA, CA, 1992 Variety Yukon Aerial appl.	EC	0.11	5	14	< 0.05, < 0.05	
USA, CA, 1992 Variety Sakata	EC	0.11	5	30	< 0.05, < 0.05	
USA, CA, 1992 Variety Yukon	EC	0.11	5	16	< 0.05, < 0.05	
USA, CA, 1992 Variety Sakata	EC	0.11	5	20	< 0.05, < 0.05	
USA, CA, 1992 Variety Yukon	EC	0.11	5	10	< 0.05, < 0.05	
USA, AZ, 1992 Variety Ravella	EC	0.11	5	16	< 0.05, < 0.05	
USA, CA, 1993	EC	0.11	5	6	< 0.05, < 0.05, < 0.05, < 0.05	IR4 PR No. 05273
USA, WA, 1993	EC	0.11	5	7	0.09, 0.05	
USA, NJ, 1994	EC	0.11	5	8	0.14, 0.12	
USA, TX,1994	EC	0.11	5	7	0.16, 0.19	

Fruiting vegetables, other than Cucurbits

Table 48 Bifenthrin residues in egg plant

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
France, 1992 Eygalieres	SC	0.04 0.4 kg ai/hL	2	2 8	< 0.1 < 0.1	BI13.2.8/17
France, 1992 Bellegarde	SC	0.04 0.4 kg ai/hL	2	1	< 0.1	
Italy, 1986	EC	0.04 0.004 kg ai/hL	2	0 3 7	0.10 0.04 0.01	FCC 107
USA, FL, 1994	EC	0.11	2	7	< 0.05, < 0.05	IR-4 PR No. 05401
USA, NJ, 1994	EC	0.11	2	7	< 0.05, < 0.05	
USA, SC, 1994	EC	0.11	2	7	< 0.05, < 0.05	

Table 49 Bifenthrin residues in peppers

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha (kg ai/hL)	No			
France, 2000	EC	0.04 (0.016)	2	3	< 0.05, < 0.05	FA-17-082 indoor
Greece, 1984	EC	0.005 (0.0007)	7	0 2 5 10 15 20	0.06, 0.05 0.07, 0.05 < 0.05 (0.03, 0.02) < 0.05 (0.04, 0.04) < 0.05 (0.01, 0.01) < 0.05, < 0.05	FCC64/2 indoor
Greece, 1984	EC	0.01 (0.001)	7	0 2 5 10 15 20	0.07, 0.05 < 0.05 (0.03, 0.04) < 0.05 (0.04, 0.04) < 0.05 (0.03, 0.03) < 0.05 (0.03, 0.03) < 0.05 (0.02, 0.02)	
Greece, 1984	EC	0.02 (0.003)	7	0 2	0.09, 0.10 0.09, 0.11	

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha (kg ai/hL)	No			
				5 10 15 20	0.05, 0.07 0.06, 0.07 < 0.05 (0.04, 0.03) < 0.05(0.04, 0.02)	
Greece, 1984	EC	0.04 (0.006)	7	0 2 5 10 15 20	0.13, 0.16 0.11, 0.12 0.14, 0.16 0.09, 0.10 0.07, 0.06 < 0.05, < 0.05	
Hungary, 1985	EC	0.40 (0.04)	2	0 1 2 3 4	0.087, 0.17, 0.25 0.13, 0.15, 0.12 0.061, 0.082, 0.059 0.095, 0.084, 0.061 0.13, 0.059, 0.12	294 indoor
Israel, 1990	EC	0.05 (0.019)	2	1 7 14 21 28	0.01, 0.02, 0.01, 0.015, 0.015 0.015, 0.02, 0.01, 0.02, 0.15 0.01, 0.01. 0.015, 0.05, 0.015 0.02, 0.01, 0.035, 0.015, 0.01 0.01, 0.01, 0.01, 0.01, 0.01	13.2.8/12 outdoor LOD 0.01 mg/kg, no information on LOQ
Israel, 1990	EC	0.1 (0.037)	2	1 7 14 21 28	0.04, 0.04, 0.06, 0.06, 0.06 0.015, 0.03, 0.03, 0.02, 0.015 0.01, 0.015, 0.06, 0.014, 0.06 0.025, 0.015, 0.07, 0.02, 0.02 0.02, 0.05, 0.02, 0.02, 0.02	
Netherlands, 2000, Horst Variety Fiesta	EC	0.040 (0.013)	2	3	< 0.05	FA-17-00-80 indoor
Netherlands, 2000, Heleaveen Variety Corcica	EC	0.041 (0.013)	2	3	0.08	
Netherlands, 2000, Horst Variety James	EC	0.0038 (0.013)	2	3	0.11	
Spain, 2000 Almeria Variety Roxy	EC	0.040 (0.0047)	2	3	0.08	FA-17-00-81 indoor
Spain, 2000 Almeria Var. Pasodoble	EC	0.040 (0.0047)	2	3	< 0.05	
Spain, 2000 Granada	EC	0.040 (0.0058)	2	3	0.17	
USA, SC, 1994	EC	0.11	2	7	0.31, 0.27	IR-4 PR No. 05280 Non-bell peppers, outdoor
USA, TX, 1994	EC	0.11	2	7	0.21, 0.09	
USA, FL, 1994	EC	0.12	2	7	0.17, 0.10	
USA, CA, 1994	EC	0.11	2	7	0.09, 0.11	
USA, NJ, 1994	EC	0.11	2	7	0.07, 0.09	
USA, LS, 1994	EC	0.08	2	7	< 0.05, < 0.05	
USA, NC, 1994	EC	0.11	2	6	0.23, 0.12	
USA, SC, 1994	EC	0.11	2	7	0.14, 0.13	IR-4 PR No. 05281 Bell peppers, outdoor
USA, TX, 1994	EC	0.11	2	7	0.10, 0.09	
USA, FL, 1994	EC	0.12	2	7	0.24, 0.09	
USA, CA, 1994	EC	0.10, 0.12	2	6	0.07, < 0.055	
USA, NJ, 1994	EC	0.11	2	7	< 0.055, < 0.055	

Table 50 Bifenthrin residues in okra

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
Cote d'Ivoire, 2004 Abengourou, dry season	EC	0.04	2	2 7	0.04 0.02	CI/AIPR/2004/03
Cote d'Ivoire, 2004 Abengourou, rainy season	EC	0.04	2	2 7	0.05 < 0.01	Analysis PIP No. 0160/22
Cote d'Ivoire, 2004 Dabou, dry season	EC	0.04	2	2 7	0.11 0.04	
Cote d'Ivoire, 2004 Dabou, rainy season	EC	0.04	2	2 7	0.09 0.01	

Table 51 Bifenthrin residues in sweet corn

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
USA, PA, 1996 Germansville	EC	0.09, 0.09, 0.04	3	1	< 0.05, < 0.05	RAN-0295
USA, PA, 1996 Hamburg	EC	0.09, 0.09, 0.04	3	1	< 0.05, < 0.05	
USA, NC, 1996 Credmore	EC	0.09, 0.09, 0.04	3	1	< 0.05, < 0.05	
USA, NC, 1996 Lucama	EC	0.09, 0.09, 0.04	3	1	< 0.05, < 0.05	
USA, FL, 1996 Bascom	EC	0.09, 0.09, 0.04	3	1	< 0.05, < 0.05	
USA, MI, 1996 Williamstone	EC	0.09, 0.09, 0.04	3	1	< 0.05, < 0.05	
USA, IL, 1996 Wyoming	EC	0.09, 0.09, 0.04	3	1	< 0.05, < 0.05	
USA, IA, 1996 Webster City	EC	0.09, 0.09, 0.04	3	1	< 0.05, < 0.05	
USA, IA, 1996 Bedford	EC	0.09, 0.09, 0.04	3	1	< 0.05, < 0.05	
USA, IN, 1996 Noblesville	EC	0.09, 0.09, 0.04	3	1	< 0.05, < 0.05	
USA, IN, 1996 Sheridan	EC	0.09, 0.09, 0.04	3	1	< 0.05, < 0.05	
USA, CA, 1996 Madera	EC	0.09, 0.09, 0.04	3	1	< 0.05, < 0.05	
USA, ID, 1996 Minidoka	EC	0.09, 0.09, 0.04	3	1	< 0.05, < 0.05	
France, 1992 Aquitaine	SC	0.02	2	2	< 0.01 (< 0.002)	R MAIS 92 01/01 LOD 0.002 mg/kg
France, 1992 Aquitaine	SC	0.02	2	14	< 0.01 (< 0.002)	
France, 1997 Chemin	SC	0.02, 0.024, 0.024	3	3	< 0.05, < 0.05	P-3337 LOD 0.05 mg/kg
France, 1997 Hinx	SC	0.02, 0.024, 0.024	3	0 1 3	< 0.05, < 0.05 < 0.05, < 0.05 < 0.05, < 0.05	P-3348 LOD 0.05 mg/kg
France, 1997 Pissos	SC	0.02, 0.024, 0.024	3	0 1 3 7	< 0.05, < 0.05 < 0.05, < 0.05 < 0.05, < 0.05 < 0.05, < 0.05	
France, 1997 La Motte	SC	0.024	3	3	< 0.05	P-3362 LOD 0.05 mg/kg
France, 1998 Southern FR Variety Super sweet	SC	0.02, 0.022	3	3	< 0.05	98-521
France, 1998 Southern FR	SC	0.02, 0.024	3	3	< 0.05	

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
Variety Sheba						
France, 1998 Southern FR Variety Challanger	SC	0.02, 0.024, 0.024	3	0 1 3 7	< 0.05 < 0.05 < 0.05 < 0.05	98-522
Hungary, 2003	EC	0.033	1	7	< 0.01, < 0.01, < 0.01	03 FMC AA 1702
Italy, 1996 Stella	SC	0.02	2	7 14	< 0.05, < 0.05 < 0.05 (0.01), < 0.05	ERSA DA 02 97
Italy, 1996 Flume Veneto	SC	0.02	2	7 14	< 0.05, < 0.05 < 0.05, < 0.05	

Table 52 Bifenthrin residues in tomato

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha (kg ai/hL)	No			
France, 1993 Birac Sur Trec	SC	0.04 (0.22)	2	0 3	< 0.05 (0.04) < 0.05	PRE-93077 outdoor
France, 1993 Verteuil Variety Nemagena	SC	0.05 (0.26)	2	0 3	0.07 < 0.05 (0.04)	
France, 1993 Verteuil Variety Perfectyl	SC	0.04 (0.27)	2	0 3	0.07 < 0.05 (0.03)	
France, 1994 Haute	SC	0.043, 0.42, 0.085, 0.085 (0.01)	4	0 7	0.03 0.02	A-17-94-11 outdoor
France, 1994 Basse	SC	0.043, 0.42, 0.085, 0.085 (0.01)	4	0 7	0.03 0.02	
France, 1994 Haute Goulaine	SC	0.04 (0.16)	2	0 7	0.06 < 0.05 (0.03)	PRE-94034 indoor
France, 1994 Basse Goulaine	SC	0.04 (0.16)	2	0 7	0.05 < 0.05 (0.03)	
France, 2005	SC	0.08 (0.08)	1	87	< 0.01	20051115/E1-FPTO outdoor
Spain, 2005	SC	0.09 (0.08)	1	89	< 0.01	
Greece, 1984	EC	0.004 (0.0005)	7	0 2 5 10 15 20	0.03 0.02 < 0.01 0.02 0.01 0.01	FCC 64/5 indoor
Greece, 1984	EC	0.0075 (0.001)	4	0 2 5 10 15 20	0.05 0.03 0.01 0.01 0.03 0.01	
Greece, 1984	EC	0.015 (0.002)	3	0 2 5 10 15 20	0.05 0.03 0.03 0.03 0.01 0.02	FCC 64/5 indoor
Greece, 1984	EC	0.03 (0.004)	3	0 2 5 10 15 20	0.05 0.05 0.04 0.04 0.06 0.04	

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha (kg ai/hL)	No			
Greece, 1986	EC	(0.002)	3	1 7 14 28	0.12 0.053 0.02 0.02	Ann. Appl. Biol. (1989), 115, 405-416 outdoor
Greece, 1986	EC	(0.002)	4	3 7 14 28	0.08 0.051 0.033 0.031	
Greece, 2005	SC	0.04 (0.0044)	2	0 2 4 7 10	< 0.01 0.01 < 0.01 < 0.01 < 0.01	20051115/E1-FGTO indoor
Hungary, 1985	EC	0.04 (0.004)	3	0 1 2 3 6 7	0.036, 0.004, < 0.002 0.032, 0.014, 0.013 0.007, 0.004, 0.003 < 0.002, 0.026, 0.014 0.027, < 0.002, 0.027 0.016, 0.006, 0.014, 0.014, 0.015, 0.024, 0.018	293 LOD 0.002 mg/kg, no LOQ reported indoor
Italy, 1986	EC	0.04 (0.4)	2	0 3 7	0.030 < 0.01 0.03	FCC 107 LOD 0.01 mg/kg no LOQ reported no information on in- or outdoor
Mexico, 1987 Los Mochis Variety Contesa	EC	0.06	4	0 1 3 7	0.06 0.08 <u>0.15</u> 0.04	FCC 128 outdoor
Mexico, 1987 Los Mochis Variety Pacific	EC	0.06	4	0 1 3 7	0.10 <u>0.06</u> 0.06 0.04	
Mexico, 1987 Culiancan Variety Carmen	EC	0.06	4	0 1 3 7	0.03 <u>0.03</u> 0.03 < 0.02	
Mexico, 1987 Culiancan Variety Aagrow	EC	0.06	4	0 1 3 7	0.05 <u>0.06</u> 0.03 0.02	
Mexico, 1988 Manedoro Variety Saladette	EC	0.06	4	0 1 3 7	0.15 <u>0.09</u> 0.09 < 0.02	
Mexico, 1988 Punta	EC	0.06	4	0 1 3 7	0.04 <u>0.04</u> 0.04 0.03	
Mexico, 1988 San Vicente	EC	0.06	4	0 1 3 7	0.10 <u>0.15</u> 0.07 0.01	
Netherlands, 1985 Variety Abunda	EC	0.1 (0.004)	1	0 3 7 14	0.02, 0.03, 0.03, 0.03 0.04, 0.08, 0.02, 0.03 0.03, 0.04, 0.03, 0.02 0.04, 0.03, 0.04, < 0.01	73/55 I LOD 0.01 mg/kg no LOQ reported
Netherlands, 1985 Variety Calypso	EC	0.1 (0.0044)	1	0 3 7 14	0.05, 0.07, 0.04, 0.04 0.04, 0.08, 0.13, 0.06 0.02, 0.03, 0.06, 0.06 0.02, 0.03, 0.04, 0.03	

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha (kg ai/hL)	No			
Poland, 1985	EC	0.15	1	1 3 6 9 13 16	0.05 0.03 0.03 0.09 0.07 0.03	FMC Pol-1986 indoor
Spain, 2005	SC	0.04 (0.0044)	2	0 2 4 7 10	0.02 0.02 0.01 0.01 0.01	20051115/E1-FGTO indoor
South Africa, 1990	EC	0.04	1	0 3 7 10 14 21	< 0.05, < 0.05 < 0.05, < 0.05 < 0.05, < 0.05 < 0.05, < 0.05 < 0.05, < 0.05 < 0.05, < 0.05	311/88800/G113 outdoor
South Africa, 1990	EC	0.08	1	0 3 7 10 14 21	0.14, 0.13 0.18, 0.19 0.10, 0.13 0.13, 0.14 0.06, 0.07 0.07, 0.08	
Spain, 1984 Robolledo	EC	0.089 (0.004)	1	0 2 6 10 15 20	0.10 0.08 0.10 0.10 0.10 0.10	73/43 (II) indoor
Spain, 1984 Robolledo	EC	0.13 (0.006)	1	0 2 6 10 15 20	0.07 0.09 0.10 0.11 0.16 0.09	
Spain, 1984 Mazarro	EC	0.082 (0.004)	1	0 2 5 9 14 19	0.12 0.10 0.17 0.06 0.03 0.03	
Spain, 1984 Mazarro	EC	0.12 (0.006)	1	0 2 5 9 14 19	0.06 0.08 0.04 0.09 0.10 0.05	
Spain, 1985 Robolledo	EC	0.08 (0.004)	3	0	0.03 0.01	73/50 III outdoor
Spain, 1985 Robolledo	EC	0.08 (0.004)	3	0	0.05	
Spain, 1985 Robolledo	EC	0.10 (0.005)	3	0 3	0.05, 0.03 0.01, 0.09, 0.05, 0.04	73-50 III outdoor
UK, 1990	EC	0.04	1	0 3 7 14	0.066, 0.069, 0.055 0.060 0.073 0.089	AS/1355/MO/3 FC 0190 indoor
		0.08	1	0 3 7 14	0.092, 0.22, 0.093 0.16 0.16 0.071	
UK, 1990	ME	0.04	2	0 3	0.043, 0.043, 0.072 0.094	

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha (kg ai/hL)	No			
				7 14	0.066 0.038	
		0.08	2	0 3 7 14	0.073, 0.089, 0.054 0.085 0.21 0.094	
UK, 1992	ME	0.08	1	0 3 8 15	0.07, 0.08, 0.09 0.07 0.08 0.07	FCC 0592 indoor
UK, 1992	TB	0.08	1	0 3 8 15	0.09, 0.10, 0.04 0.09 0.06 0.09	
USA, FL, 1990 Variety Peto	WP	0.11	8	3 5	0.08, 0.08 0.12, 0.04	P-2624 outdoor
USA, FL, 1990 Variety Heat Wave	WP	0.11	8	3 5	0.09, 0.09 0.06, 0.06	
USA, FL, 1990 Variety Sunny	WP	0.11	8	3 5	0.10, 0.14 0.16, 0.07	
USA, CA, 1992 El Centro	EC	0.11	5	3	0.14, 0.13	P-2739 outdoor
USA, CA, 1992 Reedly	EC	0.11	5	3	0.05, 0.16	
USA, CA,1992 Hanford	EC	0.11	5	3	0.04, 0.04	
USA, OH, 2000	EC	0.09	4	6	< 0.05 (0.04, 0.03)	P-3498
USA, NJ, 2000	EC	0.09	4	6	< 0.05 (0.03, 0.03, 0.03, 0.04)	outdoor
USA, FL, 2000 Variety FL 47	EC	0.09	4	5	0.06, < 0.05 (0.04)	
USA, FL, 2000 Variety Celebrity	EC	0.09	4	6	< 0.05 (0.03, 0.02)	
USA, CA, 2000 Los Banos	EC	0.09	4	5	0.07, 0.06	
USA, CA, 2000 West Sacramento	EC	0.09	4	4	0.09, 0.06	
USA, CA, 2000 Freeport	EC	0.09	4	4	0.06, 0.08	
USA, CA, 2000 Firebaugh Variety 3004	EC	0.09	4	5	0.05, 0.05	
USA, CA, 2000 Firebaugh Variety 6117	EC	0.09	4	5	< 0.05 (0.03, 0.03)	
USA, CA, 2000 Westley	EC	0.09	4	5	< 0.05 (0.03, 0.04)	
USA, CA, 2000 Lanthrop	EC	0.09	4	0 3 5 7 9	< 0.05 (0.04), 0.08 0.05, 0.07 0.08, 0.06 0.05, 0.10 < 0.05 (0.04, 0.03)	P-3498 outdoor
USA, CA, 2000 Variety Peto	EC	0.09	4	5	0.07, 0.08	
USA, CA, 2000 Variety Sunbrite	EC	0.09	4	5	0.07, < 0.05 (0.04)	
USA, CA, 2000 Variety La Roma Red	EC	0.09	4	6	< 0.05 (0.04, 0.04)	
USA, CA, 2000 Variety Sunbolt	EC	0.09	4	0 3 5 7	0.10, 0.08 0.11, 0.08 0.09, 0.09 0.07, 0.06	

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha (kg ai/hL)	No			
				9	0.05, 0.05	
USA, MI, 2000	EC	0.09	4	5	0.05, 0.06	

Leafy vegetables

Table 53 Bifenthrin residues in mustard greens

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
USA, FL, 1999	EC	0.12	4	7	1.9, 1.7	IR-4-PR No. 06970
USA, GA, 1999	EC	0.11	4	7	2.1, 2.0	
Tifton, Variety Giant curled	EC	0.11	4	7	1.4, 1.2	
USA, TN, 1999	EC	0.11–0.12	4	7	0.75, 0.91	
USA, TX, 1999	EC	0.11	4	7	0.05, 0.08	
USA, WI, 1999	EC	0.11	4	6	0.18, 0.19	
USA, CA, 1999 Parlier, Variety Broadleaf	EC	0.11–0.12	4	7	1.9, 1.5	
USA, CA, 1999 Holtville, Variety Tendergreen	EC	0.11	4	7	0.85, 0.84	

Table 54 Bifenthrin residues in radish leaves and tops. The first application was an in-furrow application of a granular formulation

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
USA, CA, 2003, Salinas, Variety Cherry Belle	GR, EC	0.1	3	6	2.0, 1.8	IR-4 PR No 08304
USA, CA, 2003, Salinas, Variety Altaglobe	GR, EC	0.1	3	7	1.7	
USA, FL, 2003, Citra, Variety Cabernet Treated 23-Oct03	GR, EC	0.1	3	7	2.3	
USA, 2003 Citra, Variety Cabernet Treated 27-Oct03	GR, EC	0.1	3	7	1.8	
USA, NY, 2003	GR, EC	0.1	3	8	1.2	
USA, OH, 2003	GR, EC	0.1	3	7	0.69	

Legume vegetables

Table 55 Bifenthrin residues in beans

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha (kg ai/hL)	No			
Green beans with pods (French beans, Snap beans)						
France, 1987 Villefranche	EC	0.04	1	7	0.09, 0.08	73/81
France, 1987 Chazay	EC	0.04	1	7	0.08, 0.07	
France, 1998 Brindas Variety Vilbel	SC	0.04	1	7 14	0.06 < 0.05	A-17-98-71
France, 1998 Brindas Variety Primel	SC	0.04	1	7 14	< 0.05 < 0.05	
France, 1998 Griesheim	SC	0.04	1	6 13	< 0.05 < 0.05	R 8175 DE

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha (kg ai/hL)	No			
France, 1998 Dingsheim	SC	0.04	1	7 14	< 0.05 < 0.05	R 8175 DE
Greece, 1984 Patra, green bean, Variety not reported	EC	0.003–0.004 (0.0005)	7	0 2 5 10 15 20	0.09 0.06 0.06 < 0.05 (0.03) < 0.05 (0.02) < 0.05	FCC 64/1
Greece, 1984 Patra, green bean, Variety not reported	EC	0.007-0.008 (0.001)	4	0 2 5 10 15 20	0.11 0.10 0.06 0.06 < 0.05 (0.03) < 0.05 (0.01)	
Greece, 1984 Patra, green bean, Variety not reported	EC	0.013-0.015 (0.002)	3	0 2 5 10 15 20	0.13 0.13 0.09 0.05 < 0.05 (0.02) < 0.05	
Greece, 1984 Patra, green bean, Variety not reported	EC	0.026-0.030 (0.004)	3	0 2 5 10 15 20	0.25 0.29 0.25 0.16 0.07 < 0.05 (0.04)	
Spain, 1985 Alcacer	EC	0.044	3	0 7 14	0.21 0.10 0.06	73/50II
Spain, 1985 Vilanova	EC	0.048	3	0 4 7 14	0.10 0.07 0.04 < 0.01	
Italy, 1997 Bovolone	SC	0.03	2	3 7	0.05 0.07	P-3349
Italy, 1997 Salierano	SC	0.03	2	3 7	< 0.05 < 0.05	
USA, FL, 1996 Snap bean	EC	0.09, 0.09, 0.04	3	3	0.15, 0.12	IR-4 PR No. 06423
USA, ID, 1996 Snap bean	EC	0.09, 0.09, 0.04	3	3	< 0.05, 0.05	
USA, IN, 1996 Snap bean	EC	0.09, 0.09, 0.04	3	3	0.06, 0.05	
USA, NY, 1996 Snap bean	EC	0.09, 0.09, 0.04	3	2	0.13, 0.09	
USA, WI, 1996 Snap bean	EC	0.09, 0.09, 0.04	3	3	0.05, < 0.05	
USA, SC, 1997 Snap bean	EC	0.09, 0.09, 0.04	3	4	< 0.05, < 0.05	
Beans without pods (succulent seeds), lima beans						
USA, CA, 1997	EC	0.09, 0.09, 0.04	3	3	< 0.05, < 0.05	IR-4 PR No. 06252
USA, MD, 1997	EC	0.09, 0.09, 0.04	3	3	< 0.05, < 0.05	
USA, NY, 1997	EC	0.09, 0.09, 0.05	3	3	< 0.05, < 0.05	
USA, SC, 1997	EC	0.09, 0.09, 0.04	3	4	< 0.05, < 0.05	
USA, WA, 1997	EC	0.09, 0.09, 0.04	3	3	< 0.05, < 0.05	
USA, WI, 1997 Hancock	EC	0.09, 0.09, 0.04	3	3	< 0.05, < 0.05	
USA, WI, 1997 Arlington	EC	0.09, 0.09, 0.04	3	2	< 0.05, < 0.05	

Table 56 Bifenthrin residues in peas

Country, Year, location	Application Form	Kg ai/ha	No	PHI, days	Commodity	Residue, mg/kg	Report
Denmark, 1986	EC	0.0075	1	22	Seed	< 0.02, < 0.02	FCC 115(a) LOD 0.02 mg/kg No information on LOQ
France, 1990	EC	0.0075	1	48	Pod	< 0.005	91-515 LOD 0.005 mg/kg No information on LOQ
France, 1993 Montdidier	SC	0.02	2	0 3 7 0 3 7	Pod Pod Pod Seed Seed Seed	0.062 0.041 0.036 < 0.01 < 0.01 < 0.01	PRE-93078/ RF-3076
France, 1993 Helencourt	SC	0.02	2	0 3 7 0 3 7	Pod Pod Pod Seed Seed Seed	0.042 0.054 0.022 < 0.01 < 0.01 < 0.01	PRE-93078/ RF-3076
France, 2001 Annoire	SC	0.02	2	7	Pod Seed	0.04 < 0.02	BKA/691/01-RES
France, 2001 Allery	SC	0.02	2	7	Pod Seed	0.04 < 0.02	
Belgium, 2001 Kortenaken Variety Giroy	SC	0.02	2	7	Pod Seed	0.06 < 0.02	
Belgium, 2001 Kortenaken Variety Lynx	SC	0.02	2	7	Pod Seed	0.06 < 0.02	
Germany, 2001 Kupferzell Treated BBCH 67	SC	0.01	2	0 3 7 8	Pod Pod Pod Green seed	< 0.01, < 0.01, 0.01, 0.03 0.011, < 0.01 < 0.01 < 0.01	20011318/01-RPS
Germany, 2001 Kupferzell Treated BBCH 71	SC	0.01	2	10 15	Pod Green seed	< 0.01 < 0.01	20011318/01-RPS
Germany, 2001 Pfaffroda Treated BBCH 69	SC	0.01	2	0 3 7 7 10 14	Pod Pod Pod Green seed Pod Green seed	< 0.01, < 0.01 < 0.01, < 0.01 < 0.01 < 0.01 < 0.01 < 0.01	20011318/01-RPS
Germany, 2001 Kummer Treated BBCH 75	SC	0.01	2	7 14	Green seed Green seed	< 0.01 < 0.01	20011318/01-RPS
Germany, 2001 Lutter	SC	0.01	2	8 15	Green seed Green seed	< 0.01 < 0.01	20011318/01-RPS
Hungary, 2003	EC	0.02	2	7	Pod	0.034, 0.031, 0.029	03 FMC AB 1701
UK, 1984	EC	0.0075	1	5 7	Seed Seed	< 0.01 < 0.01	FCC 66/2
UK, 1992 Ulceby	TB	0.004	1	0 3 7 14 7 14	Pod Pod Pod Pod Seed Seed	0.02, 0.01, 0.02 < 0.01 < 0.01 < 0.01 < 0.01 < 0.01	FCC 0792
UK, 1992 Ulceby	ME	0.004	1	0 3 7 14 7 14	Pod Pod Pod Pod Seed Seed	0.07, 0.05, 0.04 0.04 0.03 0.02 < 0.01 < 0.01	FCC 0792

Country, Year, location	Application Form	Kg ai/ha	No	PHI, days	Commodity	Residue, mg/kg	Report
UK, 1995 Sledmere	EC	0.02	2	0 3	Whole Pod Whole Pod	0.10 0.09	AK/2964/FM
UK, 1995 Duggleby	EC	0.02	2	0 3	Whole Pod Whole Pod	0.19 0.11	
UK, 1995 Goodmanham	EC	0.02	2	0 3	Whole Pod Whole Pod	0.09 0.04	
UK, 1995 Market Weighton	EC	0.02	2	0 3	Whole Pod Whole Pod	0.07 0.03	
UK, 1995 Sledmere	TB	0.056	2	0	Whole Pod	0.16	
UK, 1995 Duggleby	TB	0.048	2	0	Whole Pod	0.33	
UK, 1995 Goodmanham	TB	0.043	2	0	Whole Pod	0.27	
UK, 1995 Market Weighton	TB	0.041	2	0	Whole Pod	0.23	
UK, 2002 Harrington	SC	0.010	2	7	Pod Seed	0.010 < 0.01	20021228/GB1-FPPS
UK, 2002 Baumber	SC	0.010	2	7	Pod Seed	< 0.01 (0.009) < 0.01	
UK, 2002 Stratford	SC	0.010	2	0 3 5 7 7	Pod Pod Pod Pod Seed	0.020 < 0.01 (0.009) < 0.01 0.01 < 0.01	
UK, 2002 Thimbleby	SC	0.010	2	0 3 5 7 7	Pod Pod Pod Pod Seed	0.016 0.012 < 0.01 (0.006) < 0.01 (0.006) < 0.01	20021228/GB1-FPPS

Pulses

Table 57 Bifenthrin residues in beans, dry

Country, year, location	Application Form	kg ai/ha	No	PHI, days	Residue, mg/kg	Report
USA, WS, 2001 Fitchburg	EC	0.12	3	13	< 0.05, < 0.05 (0.01)	P-3527
USA, MN, 2001	EC	0.12	3	14	< 0.05 (0.02, 0.03)	
USA, IL, 2001	EC	0.12	3	13	< 0.05 (0.03, 0.03)	
USA, WS, 2001 Delavan	EC	0.12	3	9 14 19 27	< 0.05, < 0.05 < 0.05, < 0.05 < 0.05, < 0.05 < 0.05, < 0.05	
USA, ND, 2001	EC	0.12	3	15	< 0.05, < 0.05	
USA, CO, 2001 Eaton	EC	0.12	3	14	0.10, 0.09	
USA, CO, 2001 Wellingon	EC	0.12	3	14	0.07, 0.10	
USA, CA, 2001	EC	0.12	3	14	0.07, 0.05	
USA, ID, 2001	EC	0.12	3	15	< 0.05, < 0.05	

Table 58 Bifenthrin residues in peas, dry

Country, year, location	Application Form	kg ai/ha	No	PHI, days	Residues, mg/kg	Report
Denmark, 1986	EC	0.0075	1	35	< 0.02, < 0.02	FCC 115(a)
France, 1988	EC	0.0075	1	21	< 0.025, < 0.025	881104
France, 1988	EC	0.0075	1	104	< 0.025, < 0.025	881105
		0.015	1	104	< 0.025, < 0.025	

Country, year, location	Application			PHI, days	Residues, mg/kg	Report
	Form	kg ai/ha	No			
Germany, 2001 Kupferzell	SC	0.01	2	35 42	< 0.01 < 0.01	2011318-01-RPS
Germany, 2001 Pfaffroda	SC	0.01	2	37 44	< 0.01 < 0.01	2011318-01-RPS
Germany, 2001 Kummer	SC	0.01	4	49 56	< 0.01 < 0.01	2011318-01-RPS
Germany, 2001 Lutter	SC	0.01	4	48 55	< 0.01 < 0.01	2011318-01-RPS
Germany, 2002 Grimmitschau	SC	0.01	2	15	< 0.01	20011318/02-RPS
Germany, 2002 Seesen	SC	0.01	2	15	< 0.01	20011318/02-RPS
Poland, 1989		0.01	5	27	< 0.005	BI 13.1.6/16 LOD 0.005 mg/kg, No information on LOQ, on method, variety and formulation
Sweden, 1986 Vikingstad	EC	0.01 0.0075 0.01	1 1 1	26 43 71	< 0.01 < 0.01 < 0.01	FCC 108
Sweden, 1986 Vreta Kloster	EC	0.01 0.0075 0.01	1 1 1	29 46 74	< 0.01 < 0.01 < 0.01	FCC 108
Sweden, 1986 Flistad	EC	0.01 0.01	1 1	28 73	< 0.01 < 0.01	FCC 108
Sweden, 1986 Klockrike	EC	0.01 0.0075 0.01	1 1 1	28 45 73	< 0.01 < 0.01 < 0.01	FCC 108
Sweden, 1986 Rojleklintvej	EC	0.0075	1	35	< 0.02	FCC 115 (a)
UK, 1984 Fulbourn	EC	0.0075	2	39	< 0.01, < 0.01	FCC 66/1
UK, 1984 West Tilbory	EC	0.0075	2	37	< 0.01, < 0.01	
UK, 1984 Orsett	EC	0.0075	2	41	< 0.01, < 0.01	
UK, 2002 Thimbleby	SC	0.01	2	13	< 0.01	20021228/GB1-FPPS
UK, 2002 Stratford	SC	0.01	2	14	< 0.01	
UK, 2002 Baumber	SC	0.01	2	14	< 0.01	
UK, 2002 Harrington	SC	0.01	2	14	< 0.01	
UK, 2002 Stratton Audley	SC	0.01	2	15	< 0.01	
UK, 2002 Turkedean	SC	0.01	2	15	< 0.01	
UK, 1985 Keysoe	EC	0.0075	2	0	0.01, < 0.01	73/48 V
UK, 1985 Cambridge	EC	0.0075	2	0	< 0.01, < 0.01	
UK, 1985 Deeping	EC	0.0075	2	0	0.02, 0.04	
UK, 1985 Thornhaugh	EC	0.0075	1	0 2 4	0.03 0.02 0.04	73/48 I
USA, ND, 2001	EC	0.12	2	14	< 0.05 (0.01), < 0.05	P-3527
USA, ID, 2001 Jerome, Treated 18-Jul-01	EC	0.12	2	14	< 0.05 (0.02, 0.01)	
USA, ID, 2001	EC	0.11	2	12	< 0.05 (0.02, 0.02)	

Country, year, location	Application			PHI, days	Residues, mg/kg	Report
	Form	kg ai/ha	No			
Jerome, Treated 12-Jul-01				15 20 27	< 0.05 (0.02, 0.02) < 0.05, < 0.05 < 0.05, < 0.05	
USA, OR, 2001	EC	0.11	2	14	< 0.05 (0.01, 0.02)	
USA, WA, 2001 Walla Walla	EC	0.12	2	14	< 0.05 (0.01, 0.02)	
USA, WA, 2001 Moses Lake	EC	0.12	2	14	< 0.05 (0.01, 0.02)	

Table 59 Bifenthrin residues in soya beans, dry

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
USA, VA, 2001	EC	0.11	3	18	< 0.05, < 0.05	P-3531
USA, GA, 2001	EC	0.11	3	18	< 0.05, < 0.05	
USA, AK, 2001	EC	0.11	3	13 17 22 26	0.07, 0.06 0.07, 0.07 0.05, < 0.05 (0.04) < 0.05 (0.04, 0.04)	
USA, MS, 2001	EC	0.11	3	18	0.17, 0.18	
USA, IL, 2001	EC	0.11	3	3 10 18 26	< 0.05 (0.02, 0.02) < 0.05 (0.02, 0.02) < 0.05 (0.03, 0.04) < 0.05 (0.03, 0.02)	
USA, KN, 2001	EC	0.11	3	18	< 0.05 (0.01, 0.02)	
USA, WI, 2001	EC	0.11	3	18	< 0.05, < 0.05	
USA, IN, 2001	EC	0.11	3	18	< 0.05, < 0.05	
USA, MI, 2001	EC	0.11	3	18	< 0.05, < 0.05	
USA, MN, 2001	EC	0.11	3	18	< 0.05, < 0.05	
USA, OH, 2001	EC	0.11	3	21	< 0.05, < 0.05	
USA, SD, 2001	EC	0.11	3	18	< 0.05, < 0.05	
USA, ND, 2001	EC	0.11	3	18	< 0.05, < 0.05	
USA, NB, 2001	EC	0.11	3	18	< 0.05, < 0.05	
USA, IW, 2001	EC	0.11	3	18	< 0.05 (0.03, 0.01)	
Brazil, 1985	EC	0.0015	1	5 15 30	< 0.05, < 0.05, < 0.05 < 0.05, < 0.05, < 0.05 < 0.05, < 0.05, < 0.05	P-1238
Brazil, 1985	EC	0.003	1	5 15 30	< 0.05, < 0.05, < 0.05 < 0.05, < 0.05, < 0.05 < 0.05, < 0.05, < 0.05	

Root and tuber vegetables

Table 60 Bifenthrin residues in carrots. Foliar broadcast spray

Country, year, location	Application			PHI, days	Commodity	Residue, mg/kg	Report
	Form	kg ai/ha	No				
France, 2004 37110 Dame-Marie-les-Bois	SC	0.02	5	3 7 10 15	Whole plant Roots Roots Roots	0.30 < 0.01 < 0.01 < 0.01	X-04-142-710
France, 2004 47400 Gontaud	SC	0.02	5	0 3 6 10 13	Whole plant Whole plant Roots Roots Roots	0.07 0.26 < 0.01 < 0.01 < 0.01	X-04-142-710
France, 2004 42170 Mezin	SC	0.02	5	14 15	Whole plant Roots	0.06 < 0.01	X-04-142-710
Germany, 2004	SC	0.02	5	13 13	Whole plant Roots	0.03 < 0.01	X-04-142-710

Country, year, location	Application			PHI, days	Commodity	Residue, mg/kg	Report
	Form	kg ai/ha	No				
Italy, 2004	SC	0.02	5	13 13	Whole plant Roots	0.09 < 0.01	X-04-142-710
Italy, 2002 Treated 05-Nov-03	SC	0.02	1	7	Roots	< 0.05	SIP1394
Italy, 2002 Treated 22-Oct-03	SC	0.02	1	0 7 14 21	Whole plant Whole plant Roots Roots	0.16 < 0.05 (0.025) < 0.05 < 0.05	
Italy, 2002	SC	0.02	1	7	Roots	< 0.05	B14/CA
Italy, 2002	SC	0.02	1	6	Roots	< 0.05	
Netherlands, 2004	SC	0.02	5	13 14	Whole plant Roots	0.03 < 0.01	X-04-142-710
Spain, 2004	SC	0.02	5	3 7 10 14	Whole plant Roots Roots Roots	0.26 < 0.01 < 0.01 < 0.01	X-04-142-710
UK, 2004	SC	0.02	5	3 7 9 14	Whole plant Roots Roots Roots	0.25 < 0.01 < 0.01 < 0.01	X-04-142-710
USA, CA, 2002 Treated 19-Jul-02	EC	0.34, 0.12, 0.11	3	21	Roots	< 0.05	IR-4 PR No. 07089
USA, CA, 2002 Treated 29-Jan03	EC	0.34, 0.12, 0.11	3	21	Roots	< 0.05	
USA, CA, 2002 Treated 09-Oct-02	EC	0.33, 0.11, 0.12	3	7 14 21	Roots	< 0.05 < 0.05 < 0.05	
USA, CA, 2002 Treated 13-Aug-02	EC	0.34, 0.11, 0.11	3	22	Roots	< 0.05	
USA, FL, 2002	EC	0.33, 0.11, 0.11	3	21	Roots	< 0.05	
USA, IN, 2002	EC	0.34, 0.11, 0.11	3	20	Roots	< 0.05	
USA, OH, 2002	EC	0.34, 0.11, 0.11	3	21	Roots	< 0.05	
USA, TX, 2002 Treated 11-Mar-02	EC	0.34, 0.11, 0.11	3	7 14 21	Roots	< 0.05 < 0.05 < 0.05	
USA, TX, 2002 Treated 07-May-02	EC	0.33, 0.11, 0.11	3	22	Roots	< 0.05	
USA, WA, 2002	EC	0.34, 0.12, 0.11	3	21	Roots	< 0.05	

Table 61 Bifenthrin residues in potatoes

Country, year location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
Belgium, 2003	SC	0.01	6	0 1 3 7	< 0.01 < 0.01 < 0.01 < 0.01	20031174/E1-FPPO
Brazil, 2003 Sao Joao da Boa	EC	0.01	5	0 1 5 7 14	< 0.02 < 0.02 < 0.02 < 0.02 < 0.02	BR244
Brazil, 2003 Sao Joao da Boa	EC	0.02	5	0 1 5 7 14	< 0.02 < 0.02 < 0.02 < 0.02 < 0.02	

Country, year location	Application Form	kg ai/ha	No	PHI, days	Residue, mg/kg	Report
Brazil, 2003 Vargem Grande do Sul	EC	0.01	5	0 1 5 7 14	< 0.02 < 0.02 < 0.02 0.03 < 0.02	BR245
Brazil, 2003 Vargem Grande do Sul	EC	0.02	5	0 1 5 7 14	< 0.02 < 0.02 < 0.02 < 0.02 < 0.02	
Brazil, 2003 Andradas	EC	0.01	5	0 1 5 7 14	< 0.02 < 0.02 < 0.02 < 0.02 < 0.02	BR246
Brazil, 2003 Andradas	EC	0.02	5	0 1 5 7 14	< 0.02 < 0.02 < 0.02 < 0.02 < 0.02	
Brazil, 2003 Socorro	EC	0.15	1	35	< 0.02	BR248
	EC	0.30	1	35	< 0.02	
Brazil, 2003 Andradas	EC	0.15	1	35	< 0.02	BR249
	EC	0.30	1	35	< 0.02	
Brazil, 2003 Divinolandia	EC	0.15	1	35	< 0.02	BR250
	EC	0.30	1	35	< 0.02	
France, 2003	SC	0.01	5	0 1 3 7	< 0.01 < 0.01 < 0.01 < 0.01	20031174/E1-FPPO
France, 2004 Quinieux	SC	0.01	2	7	< 0.01	20041181/E1-FPPO
France, 2004 Miribel	SC	0.01	2	7	< 0.01	
Germany, 2002 Kottmansweiler Variety Selma	SC	0.01	2	7 14	< 0.01 < 0.01	20011318/01-RPO
Germany, 2002 Ebersbach	SC	0.01	2	7 14	< 0.01 < 0.01	
Germany, 2002 Weidensdorf	SC	0.01	2	0 3 6 14 21	< 0.01 < 0.01 < 0.01 < 0.01 < 0.01	
Germany, 2002 Kottmansweiler Variety Granola	SC	0.01	3	0 3 7 14 21	< 0.01 < 0.01 < 0.01 < 0.01 < 0.01	20011318/01-RPO
Italy, 2004	SC	0.01	2	7	< 0.01	20041181/E1-FPPO
Italy, 2004 Salerno	SC	0.02	1	7	< 0.018	SIP1426
Italy, 2004 Vicobellignano	SC	0.02	1	7	< 0.018	
Italy, 2005 Budrio	SC	0.01	8	7	< 0.01	SIP1456
Italy, 2005 Martignana	SC	0.01	8	0 1 3 7	< 0.01 < 0.01 < 0.01 < 0.01	
Netherlands, 2003	SC	0.01	6	0 1 3	< 0.01 < 0.01 < 0.01	20031174/E1-FPPO

Country, year location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
				7	< 0.01	
Netherlands, 2004 Nordbroek	SC	0.01	10	7	< 0.01	20041181/E1-FPPO
Netherlands, 2004 Zyldyk	SC	0.01	10	7	< 0.01	
South Africa, 1989	EC	0.06	2	15	< 0.02	311/88708/F458 LOD 0.02 mg/kg
Spain, 2004	SC	0.01	2	7	< 0.01	20041181/E1-FPPO
Sweden, 1987 Tralleborgsgard	EC	0.015	1	85	< 0.05	FCC 126
Sweden, 1987 Kristianstad	EC	0.015	1	80	< 0.05	
Sweden, 1987 Arnaberga	EC	0.015	1	96	< 0.05	
Sweden, 1987 Eldsberga	EC	0.015	1	92	< 0.05	
UK, 1985 Essex, Variety Romano	EC	0.075	2	42	< 0.01, < 0.01	73/49
UK, 1985 Essex, Variety M Pieper	EC	0.075	2	42	< 0.01, < 0.01	
UK, 1985 Essex, Variety Squire	EC	0.075	2	35	< 0.01, < 0.01	
UK, 2003	SC	0.01	6	7	< 0.01	20031174/E1-FPPO
USA, WA, 1990	EC	0.11	3	21	< 0.05	P-2568
USA, OR, 1990	EC	0.11	3	21	< 0.05	
USA, ID, 1992	EC	0.12	3	21	< 0.05	P-2793
USA, MN, 1992	EC	0.12	3	21	< 0.05	
USA, OR, 1992	EC	0.10	3	21	< 0.05	
USA, WA, 1992	EC	0.10	3	21	< 0.05	
USA, NY, 2001 Dundee	GR, EC	0.34, 0.11, 0.11	3	21	< 0.05	P-3526
	EC	0.34, 0.11, 0.11	3	21	< 0.05	
USA, NY, 2001 North Rose	GR, EC	0.34, 0.11, 0.11	3	14 21 28 35	< 0.05, < 0.05 < 0.05, < 0.05 < 0.05, < 0.05 < 0.05, < 0.05	
	EC	0.34, 0.11, 0.11	3	14 21 28 35	< 0.05, < 0.05 < 0.05 (0.01, 0.02) < 0.05, < 0.05 < 0.05, < 0.05 (0.01)	
USA, NC, 2001	GR, EC	0.34, 0.11, 0.11	3	21	< 0.05, < 0.05	
	EC	0.34, 0.11, 0.11	3	21	< 0.05, < 0.05 (0.01)	
USA, FL, 2001	GR, EC	0.34, 0.11, 0.11	3	14	< 0.05, < 0.05	
	EC	0.34, 0.11, 0.11	3	14	< 0.05, < 0.05	
USA, WS, 2001	GR, EC	0.34, 0.11, 0.11	3	20	< 0.05, < 0.05	
	EC	0.34, 0.11, 0.11	3	20	< 0.05 (0.02, 0.02)	
USA, ND, 2001	GR, EC	0.34, 0.11, 0.11	3	21	< 0.05, < 0.05	
	EC	0.34, 0.11, 0.11	3	21	< 0.05, < 0.05	
USA, CO, 2001	GR, EC	0.34, 0.11, 0.11	3	21	< 0.05, < 0.05	
	EC	0.34, 0.11, 0.11	3	21	< 0.05, < 0.05	
USA, CA, 2001	GR, EC	0.34, 0.11, 0.11	3	21	< 0.05, < 0.05	
	EC	0.34, 0.11, 0.11	3	21	< 0.05, < 0.05	
USA, WA, 2001 Moses Lake	GR, EC	0.34, 0.11, 0.11	3	21	< 0.05 (0.01), < 0.05	
	EC	0.39, 0.11, 0.11	3	21	< 0.05, < 0.05	
USA, WA, 2001 Walla Walla	GR, EC	0.34, 0.11, 0.11	3	21	< 0.05, < 0.05	
	EC	0.34, 0.11, 0.11	3	21	< 0.05, < 0.05	
USA, ID, 2001 Jerome	GR, EC	0.34, 0.11, 0.11	3	21	< 0.05, < 0.05 (0.02)	
	EC	0.34, 0.11, 0.11	3	21	< 0.05, < 0.05	
USA, ID, 2001 Rupert	GR, EC	0.34, 0.11, 0.11	3	14 21 28	< 0.05, < 0.05 < 0.05, < 0.05 < 0.05, < 0.05	

Country, year location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
				35	< 0.05, < 0.05	
	EC	0.34, 0.11, 0.11	3	14 21 28 35	< 0.05, < 0.05 < 0.05, < 0.05 < 0.05, < 0.05 < 0.05, < 0.05	

Table 62 Bifenthrin residues in radish. The first application was an in-furrow application of a granular formulation

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
USA, CA, 2003 Salinas, Variety Cherry Belle	GR, EC	0.1	3	6	0.06	IR-4 PR No. 08304
USA, CA, 2003 Salinas, Variety Altaglobe	GR, EC	0.1	3	7	< 0.03	
USA, FL, 2003 Citra, Variety Cabernet Treated 23-Oct-03	GR, EC	0.1	3	7	< 0.03	
USA, FL, 2003 Citra, Variety Cabernet Treated 27-Oct-03	GR, EC	0.1	3	7	0.07	
USA, NY, 2003	GR, EC	0.1	3	8	< 0.03	
USA, OH, 2003	GR, EC	0.1	3	7	< 0.03	

Table 63 Bifenthrin residues in sugar beet roots

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
France, 1998 Stattmatten	SC	0.024	2	28	< 0.05	13.1.3/4
France, 1998 Seebach	SC	0.024	2	30	< 0.05	
France, 1998 Barly	EC	0.03	2	0 8 14 29	< 0.05 < 0.05 < 0.05 < 0.05	13.1.3/5
France, 1998 Saint Bernard	EC	0.03	2	0 8 14 28	< 0.05 < 0.05 < 0.05 < 0.05	
France, 1999 Cardonette	EC	0.03	2	28	< 0.05	13.1.3/7
France, 1999 Crimolois	EC	0.03	2	28	< 0.05	

Cereal grains

Table 64 Bifenthrin residues in barley

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
Denmark, 1986	EC	0.0075	1	37	< 0.02, 0.02	FCC 115(a)
Finland, 1986	EC	0.01	1	92	< 0.03	13.1.1/3
France, 1983 Treated 17-Nov-82	EC	0.005	1	245	< 0.02	FCC 67/1
		0.008	1	245	< 0.02	

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
		0.01	1	245	< 0.02	
France, 2003 Les Cheres	SC	0.008	2	28	0.01	20031328/01-RCE
France, 2003 Joyeux	SC	0.008	2	27	0.02	
France, 2007 Montauban	SC	0.01	2	33	0.02	20074083/E1-FPWB
France, 2007 Montfermier	SC	0.01	2	37	0.02	20074083/E1-FPWB
Germany, 1992 Giggenhausen	SC	0.008	1	35	0.024, 0.032	NA 92 1274
Germany, 1992 Ismaning	SC	0.008	1	35	0.016, 0.017	NA 92 1274
Germany, 2001 Kottmansweiler Variety Regina	SC	0.0075	2	35 41	0.023 0.023	20011318/01-RWB
Germany, 2001 Weidensdorf	SC	0.0075	2	35 43	< 0.01 (0.006) < 0.01 (0.008)	20011318/01-RWB
Germany, 2001 Kottmansweiler Variety Duett	SC	0.0075	2	35 42	0.01 0.012	20011318/02-RWB
Germany, 2002 Riedback	SC	0.0075	2	35 41	< 0.01 (0.008) < 0.01 (0.006)	20011318/ 01 RSBA
Germany, 2002 Blumenhagen	SC	0.0075	2	36 41	< 0.01 (0.007) < 0.01 (0.004)	20011318/ 01 RSBA
Germany, 2002 Ebersheim	SC	0.008	2	42	0.015	20021228/ E1-FPCE
Greece, 2007 Melissohori	SC	0.01	2	35	0.01	20074083/E1-FPWB
Greece, 2007 Akropotomia	SC	0.01	2	35	0.01	
Italy, 2007 Conselice	SC	0.01	2	29	0.04	20074083/E1-FPWB
Italy, 2007 Grandola	SC	0.01	2	31	0.07	
Poland, 2007 Kluczewo	SC	0.01	2	35	0.03	20074083/E1-FPWB
Poland, 2007 Otorowo	SC	0.01	2	34	0.02	
Sweden, 1985 Agersta	EC	0.005	1	75	< 0.01	FCC 104
Sweden, 1985 Strängshäs	EC	0.005	1	61	< 0.01	
Sweden, 1985 Anaberga	EC	0.005	1	66	< 0.01	
UK, 1984 Snifnal	EC	0.005	2	179	< 0.02	FCC 66/4
UK, 1984 Salisbury	EC	0.005	2	128	< 0.02	
UK, 1984 Cressing	EC	0.005	2	158	0.03	
UK, 1985 Blakemere	EC	0.0075	2	261	< 0.01, < 0.01	73/48 II
UK, 1985 Dorchester	EC	0.0075	2	262	< 0.01, < 0.01	
UK, 1985 W. Hesleton	EC	0.0075	2	175	< 0.01, < 0.01	73/ 48 II

Table 65 Bifenthrin residues in maize

Country, year	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
USA, TX, 1984 La Feria	EC	0.11	5	38	< 0.05, < 0.05	RAN-0152
USA, IN, 1984 Mt. Vernon	EC	0.11	5	43	< 0.05, < 0.05	
USA, IN, 1984 Mt. Vernon Last 3 appl aerial	EC	0.11	5	43	< 0.05, < 0.05	
USA, MO, 1984 Charleston	EC	0.11	5	68	< 0.05, < 0.05	
USA, TX, 1984 Tulia	EC	0.11	5	50	< 0.05, < 0.05	
USA, IL, 1984 Champaign	EC	0.11	5	56	< 0.05, < 0.05	
USA, TX, 1984 Dalhart	EC	0.11	5	45	< 0.05, < 0.05	
USA, NC, 1984 Yadkinville	EC	0.11	5	45	< 0.05, < 0.05	
USA, CO, 1984 Wray Last 3 appl aerial	EC	0.11	5	60	< 0.05, < 0.05	
USA, CO, 1984 Wray	EC	0.11	5	60	< 0.05, < 0.05	
USA, NY, 1984 Phelps	EC	0.11	5	64	< 0.05, < 0.05	
USA, CA, 1984 Turlock	EC	0.11	5	60	< 0.05, < 0.05	
USA, CA, 1986	EC	0.11	5	30	< 0.05, < 0.05	P-1645
		0.11, 0.11, 0.11, 0.11, 0.11, 1.1	6	31	< 0.05, < 0.05	
USA, AL, 1986	EC	0.11	5	31	< 0.05, < 0.05	
USA, NE, 1986	EC	0.11	5	33	< 0.05, < 0.05	
USA, PA, 1986	EC	0.11	5	65	< 0.05, < 0.05	
		0.11, 0.11, 0.11, 0.11, 1.1	5	65	< 0.05, < 0.05	
USA, OH, 1987	EC	0.11	5	39	< 0.05, < 0.05	P-2547 P-2550 analysis
USA, TX, 1987	EC	0.11	5	46	< 0.05, < 0.05	
USA, CA, 1987	EC	0.11	5	54	< 0.05, < 0.05	
USA, IA, 1987	EC	0.11	5	49	< 0.05, < 0.05	
USA, IL, 1987	EC	0.11	5	29	< 0.05, < 0.05	
USA, MN, 1987	EC	0.11	5	35	< 0.05, < 0.05	
USA, NY, 1987	EC	0.11	5	47	< 0.05, < 0.05	
USA, OH, 1987	EC	0.11, 0.11, 0.11, 0.11, 1.1	5	39	< 0.05, < 0.05	P-2548 P-2550 analysis
USA, CA, 1987	EC	0.11, 0.11, 0.11, 0.11, 1.1	5	54	< 0.05, < 0.05	
USA, IL, 1987	EC	0.11, 0.11, 0.11, 0.11, 1.1	5	33	< 0.05, < 0.05	
USA, PA, 1987	EC	0.11	5	55	< 0.05, < 0.05	P-2549
USA, WI, 1987	EC	0.11	5	30	< 0.05, < 0.05	P-2550 analysis
USA, IL, 2002	EC	0.11, 0.06, 0.06, 0.06, 0.06	5	1 3 7 14	< 0.05, < 0.05 < 0.05, < 0.05 < 0.05, < 0.05 < 0.05, < 0.05	P-3593
USA, NE, 2002	GR, EC	0.11, 0.06, 0.06, 0.06, 0.06	5	1 3 7 15	< 0.05, < 0.05 < 0.05, < 0.05 < 0.05, < 0.05 < 0.05, < 0.05	
France, 1986 Thodure	EC	0.02	1	101	< 0.01	73/60 LOD 0.01 mg/kg

Country, year	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
France, 1986 Loury	EC	0.02	1	102	< 0.01	
France, 1986 Thodure	GR	0.015	1	94	< 0.01	
France, 1986 Loury	GR	0.015	1	100	< 0.01	
France, 1987 Genas	EC	0.02	1	84	< 0.01, < 0.01	73/74 LOD 0.01 mg/kg
France, 1987 Coulmiers	EC	0.02	1	88	< 0.01, < 0.01, < 0.01, < 0.01	
Germany, 2004	SC	0.12	1	139	< 0.01	20041181/E1-FPMA LOD 0.003 mg/kg
France, 2004 Quincieux	SC	0.099	1	159	< 0.01	
France, 2004 Versailleux	SC	0.11	1	104 178	< 0.01 < 0.01	
Hungary, 2004	SC	0.12	1	100 145	< 0.01 < 0.01	
Hungary, 2003	EC	0.033	1	7	< 0.01, < 0.01, < 0.01	03 FMC AA 1702
Italy, 2002	SC	0.02	1	7	< 0.05	BI4/MA
Italy, 2003 Stella	SC	0.02	1	7 14	< 0.05 < 0.05	SIP1392
Italy, 2003 Flume Veneto	SC	0.02	1	7 14	< 0.05 < 0.05	

Table 66 Bifenthrin residues in oat

Country, year, location	Application				PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	kg ai/hL	No			
France, 2002	SC	0.008		2	41	< 0.01 (0.003)	20021228/E1/FPCE
Sweden, 1985 Växjo	EC	0.02		1	129	< 0.01	FCC 104 LOD 0.01 mg/kg
Sweden, 1985 Jonkopig	EC	0.02		1	118	< 0.01	
Sweden, 1985 Orsundsbro	EC	0.005		1	74	< 0.01	
Sweden, 1985 Nyköping	EC	0.005		1	77	< 0.01	
Sweden, 1985 Ortomia	EC	0.005		1	81	< 0.01	
Sweden, 1985 Karlsund	EC	0.005		1	66	< 0.01	
Sweden, 1987 Svalov	EC		0.01	1	70	< 0.01	FCC 126 LOD 0.01 mg/kg
Sweden, 1987 Kungsgard	EC		0.01	1	75	< 0.01	
Sweden, 1987 Malmoe	EC		0.01	1	NR	< 0.01	
UK, 2002	SC	0.007-0.008		2	41	< 0.01	20021228/E1/FPCE

NR not reported

Table 67 Bifenthrin residues in triticale

Country, year	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
Germany, 2001	SC	0.008	2	34	< 0.01	20011318/01-RTR
				43	< 0.01	
UK, 2002	SC	0.007	2	43	< 0.01	20021228/E1/FPCE

Table 68 Bifenthrin residues in wheat grain after foliar treatment

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
Australia, 1996	EC	0.01	1	142	< 0.01	96/0798
Australia, 1996	EC	0.02	1	145	< 0.01	
Denmark, 1986	EC	0.075	1	37	< 0.02, < 0.02	FCC 115(a)
Finland, 1986	EC	0.015	1	53	< 0.05	13.1.1/3 Recoveries unknown
France, 1984 Andonville	EC	0.008	1	58	< 0.02	FCC 67/3
	EC	0.01	1	58	< 0.02	
France, 1984 Atraps	EC	0.008	1	57	< 0.02	
	EC	0.01	1	57	< 0.02	
France, 1984 Vendin-le-Vieil	EC	0.008	1	64	< 0.02	FCC 67/2
		0.01	1	64	< 0.02	
France, 1984 Chippilly	EC	0.008	1	69	< 0.02	
		0.01	1	69	< 0.02	
France, 1984 Le Hamel	EC	0.008	1	69	< 0.02	
		0.01	1	69	< 0.02	
France, 1985 Vignacourt	EC	0.0063	1	60	< 0.05	FCC 93
France, 1985 Courlandon	EC	0.006	1	28	< 0.05	FCC 93B (ii)
France, 2003 Versailleux	SC	0.008	2	27	< 0.01	20031328/01-RCE
France, 2003 Saint Laurent	SC	0.008	2	28	< 0.01 (0.006)	20031328/01-RCE
France, 2007 Montauban	SC	0.01	2	35	< 0.01	20074083/E1-FPWW
France, 2007 Notre Dame de la Croix	SC	0.01	2	35	< 0.01	
France, 2009 Romanswiller	SC	0.01	2	35	< 0.01	S09-00398
France, 2009 Rouvres-St.-Jean	SC	0.01	2	35	< 0.01	
Germany, 1992 Variety Ares	SC	0.008	1	61	< 0.01	NA 92 1274
Germany, 1992 Landsberg, Variety Orestis	SC	0.008	1	52	< 0.01	NA 92 1274
Germany, 2001 Riedbach	SC	0.0075	2	35 41	< 0.01 < 0.01	20011318/02-RWW
Germany, 2001 Kottmansweiler	SC	0.0075	2	35 42	< 0.01 < 0.01	20011318/01-RWW
Germany, 2001 Lutter	SC	0.0075	2	35 42	< 0.01 < 0.01	
Germany, 2002 Riedback	SC	0.0077	2	35 42	< 0.01 < 0.01	20011318/01-RSWH
Germany, 2002 Jahnsdorf	SC	0.0078	2	35 42	< 0.01 < 0.01	
Germany, 2009	SC	0.01	2	35	< 0.01	S09-00398
Greece, 2007 Kilkis, Variety Mesapia	SC	0.01	2	34	< 0.01	20074083/E1-FPWW
Greece, 2007 Kilkis, Variety Bronde	SC	0.01	2	34	< 0.01	20074083/E1-FPWW
Hungary, 2007	SC	0.01	2	33	< 0.01	20074083/E1-FPWW
Italy, 2007 Concelice	SC	0.01	2	35	< 0.01	20074083/E1-FPWW
Italy, 2007 Budrio	SC	0.01	2	30	0.02	
Italy, 2009	SC	0.01	2	35	< 0.01	S09-01173
Poland, 2007	SC	0.01	2	35	< 0.01	20074083/ E1-FPWW

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
Spain, 2009	SC	0.01	2	35	< 0.01	S09-01173
Sweden, 1985 Kividinge	EC	0.015	1	86	< 0.05	FCC 104
Sweden, 1985 Valläkra	EC	0.015	1	81	< 0.05	
Sweden, 1985 Furulund	EC	0.015	1	77	< 0.05	
Sweden, 1985 Jordberga	EC	0.005	1	77	< 0.05	
		0.0075	1	77	< 0.05	
		0.1	1	77	< 0.05	
Switzerland, 1985	EC	0.025	1	54	< 0.01, < 0.01	6123 85067
Switzerland, 1985	EC	0.025	1	54	< 0.01	SWI 85.2.313
UK, 1984 Upton Magna	EC	0.005	2	199	< 0.02	FCC 66/4 LOD 0.02 mg/kg
UK, 1984 Bromyard	EC	0.005	2	199	< 0.02	
UK, 1984 Brighton	EC	0.005	2	158	0.02	
UK, 1984 Ongar, Essex Variety Fenman	EC	0.005	1	287	< 0.01, < 0.01	FCC 77 LOD 0.01 mg/kg
UK, 1984 Essex Variety Counsellor	EC	0.005	1	278	< 0.01, < 0.01	
UK, 1985 Essex Variety Avalon	EC	0.006	2	196	< 0.05, < 0.05	73/48 IV
UK, 1985 Essex Variety Armada	EC	0.006	2	189	< 0.05, < 0.05	
UK, 1985 Essex Variety Galahad	EC	0.006	2	189	< 0.05, < 0.05	
UK, 2002	SC	0.003	2	43	< 0.01	20021228/E1/FPCE
UK, 2009 North Cave Variety Robicus	SC	0.01	2	62	< 0.003	S09-00398
UK, 2009 North Cave Variety Consort	SC	0.01	2	35	< 0.003	
UK, 2009 North Cave Variety Oakley	SC	0.01	2	35	< 0.01	

Table 69 Bifenthrin residues in stored wheat grain

Country, year	Application			DALA, days	Residue, mg/kg		Report
	Form	kg ai/t	No		Fresh	Dry	
Australia, 1995	EC	0.0005	1[a]	0 45 90 135 180	0.56, 0.5 0.32, 0.4 0.43, 0.4 0.37 0.43, 0.4		13.4.1/26
Belgium, 1994 Silo 3	EC	0.0003	1[a]	1 30 90 180 365	0.18 <u>0.19</u> 0.14 0.15 0.15		13.4.1.2
Belgium, 1994 Silo 4	EC	0.0003	1[a]	1 30 90 180	0.23 0.16 < 0.01 <u>0.25</u>		

Country, year	Application			DALA, days	Residue, mg/kg		Report
	Form	kg ai/t	No		Fresh	Dry	
				365	0.12		
Belgium, 1994 Silo 1	UL	0.0003	1[a]	1 30 90 180 365	0.18 0.17 <u>0.22</u> 0.14 0.16		
Belgium, 1994 Silo 2	UL	0.0003	1[a]	1 30 90 180 365	0.23 0.23 <u>0.24</u> 0.14 0.19		
Brazil, 1995	EC	0.0004	1	0 15 30 60	0.4 0.3 <u>0.2</u> 0.1		13.4.1/12
Brazil, 1995	EC	0.0008	1	0 15 30 60	0.6 0.7 0.5 0.3		
France, 1992	EC	0.0003	1[a]	1 ~30 ~90 ~180 ~365	0.24 0.20 <u>0.21</u> 0.21 0.19		13.4.1/4 (treatment) 73/89-1012 (analysis)
France, 1992	UL	0.0003	1[a]	1 ~30 ~90 ~180 ~365	0.23 0.22 0.23 0.22 <u>0.26</u>		
France, 1994	EC	0.0003	1[b]	0 90 180	0.30, 0.32 0.27, 0.27 0.25, 0.25		13.4.1/16 (treatment) CRP/95/1362 (analysis)
			1[c]	0 90 180	0.32, 0.32 0.28, 0.27 0.24, 0.24		
France, 1994	UL	0.0003	1[b]	0 90 180	0.28, 0.24 0.25, 0.24 0.20, 0.21		
			1[c]	0 90 180	0.28, 0.28 0.24, 0.23 0.22, 0.22		
Hungary, 2002	EC	0.0003	1[a]	1 31 61 94 123 182	0.22, 0.22 0.16, 0.19 0.21, 0.21 0.20, 0.21 0.17, 0.19 0.22, 0.18, <u>0.23</u>		13.4.1/32 and 02-KWIZ-AB-14-06
UK, 1992	EC	0.0003	1[a]	1 ~30 ~90 ~180 ~365	0.25 0.26 0.24 <u>0.27</u> 0.22		AB09 (treatment) 73/89-1012 (analysis)
UK, 1992	UL	0.0003	1[a]	1 ~30 ~90 ~180 ~365	0.26 0.23 0.25 <u>0.28</u> 0.24		
UK, 1992	EC	0.0005	1[a]	1 ~30 ~90 ~180 ~365	0.37 0.39 0.38 0.39 <u>0.40</u>		
UK, 1995	EC	0.0003	1[b]	1 28	0.24, 0.25 0.25, 0.23	0.27, 0.28 0.29, 0.26	13.4.1/14 (treatment) CRP/95/1363 (analysis)

Country, year	Application			DALA, days	Residue, mg/kg		Report
	Form	kg ai/t	No		Fresh	Dry	
				56 84	0.25, 0.24 0.22, 0.26	0.29, 0.27 0.25, 0.29	
UK, 1995	UL	0.0003	1[b]	1 28 56 84	0.23, 0.25 0.23, 0.25 0.23, 0.23 0.19, 0.24	0.26, 0.28 0.26, 0.28 0.26, 0.26 0.21, 0.27	

[a] Stored at ambient temperature

[b] Stored at 20 °C

[c] Stored at 25 °C

Tree nuts

Table 70 Bifenthrin residues in meat of tree nuts

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
Italy, 2003 Perletto	SC	0.02	1	0 7 14	< 0.05 < 0.05 < 0.05	SIP-1393 Hazelnut
Italy, 2003 Castino	SC	0.02	1	0 7 14	< 0.05 < 0.05 < 0.05	
USA, CA, 1984 Clovis	WP	0.22	4	7	< 0.05 (0.01), < 0.05	RAN-0142 Walnut
USA, CA, 1984 Winters	WP	0.22	4	7	< 0.05 (0.01), < 0.05	
USA, OR, 1984	WP	0.22	4	7	< 0.05 (0.01), < 0.05	
USA, CA, 1984 Live Oak	WP	0.22	4	7	< 0.05,< 0.05	
USA, CA, 1984 Hughson	WP	0.22	4	7	< 0.05 (0.02), < 0.05	
USA, TX, 1984	WP	0.22	8	21	< 0.05,< 0.05	P-1109 Pecan
USA, GA, 1984 Tifton	WP	0.22	8	21	< 0.05,< 0.05	
USA, GA, 1984 Plains	WP	0.22	8	21	< 0.05,< 0.05	
USA, SC, 1984 Lughoff	WP	0.22	8	22	< 0.05,< 0.05	
USA, CA, 1985 Escalon	WP	0.22	4	7	< 0.05,< 0.05	RAN-0185 Walnut
USA, CA, 1985 Live Oak	WP	0.22	4	7	< 0.05,< 0.05	
USA, CA, 1985 Winters	WP	0.22	3	7	< 0.05,< 0.05	
USA, SC, 1985 Bishopsville	WP	0.22	8	23	< 0.05,< 0.05	RAN-0186 Pecan
USA, AZ, 1985	WP	0.22	8	22	< 0.05,< 0.05	
USA, OR, 1986 Corvallis	WP	0.22	4	14	< 0.05 (0.01, 0.02)	P-2562 Filbert
USA,WA, 1986 Vancouver	WP	0.22	4	14	< 0.05,< 0.05	
USA, OR, 1986 Salem	WP	0.22	4	14	< 0.05 (0.02),< 0.05	
USA, OR, 1989 Keizer	WP	0.22	4	14	< 0.05,< 0.05	
USA, OR, 1989 Junction City	WP	0.22	4	14	< 0.05,< 0.05	
USA,WA, 1989 Vancouver	WP	0.22	4	14	< 0.05 (0.02, 0.02)	

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
USA, LS, 1987 Monroe Variety Cherokee	WP	0.22	8	21	< 0.05,< 0.05	PC-0132 Pecan
USA, LS, 1987 Monroe Variety Candy	WP	0.22	8	21	< 0.05,< 0.05	
USA, GA, 1987 Quitman	WP	0.22	8	21	< 0.05,< 0.05	
USA, TX, 1987 Erath	WP	0.22	8	21	< 0.05,< 0.05	
USA, TX, 1988 La Pryor	WP	0.22	8	21	< 0.05,< 0.05	
USA, TX, 1989 Erath	WP	0.22	8	21	< 0.05,< 0.05	
USA, OR, 1988 Keiger	WP	0.22	4	7	< 0.05,< 0.05	PC-0133 Walnut
USA, OR, 1988 Hillsboro	WP	0.22	4	7	< 0.05,< 0.05	
USA, CA, 1989 Madera	WP	0.11	4	6	< 0.05,< 0.05	P-2556 Pistachio
USA, CA, 1989 Tulare	WP	0.11	4	7	< 0.05,< 0.05	
	WP	0.11	4	7	< 0.05,< 0.05	
USA, CA, 1989 Kings	WP	0.11	4	8	< 0.05 (0.01, 0.01)	
USA, CA, 1989 Fresno	WP	0.11	4	6	< 0.05,< 0.05	
	WP	0.11	4	6	< 0.05 (0.02, 0.01)	
USA, CA, 1990 Visalia Variety Franquette	WP	0.22	4	7	< 0.05,< 0.05	P-2578 Walnut
USA, CA, 1990 Visalia Variety Hartley	WP	0.22	4	7	< 0.05,< 0.05	
USA, CA, 1999 Lemoore	WP	0.22, 0.11, 0.22, 0.11, 0.11	5	7	< 0.05 (0.01, 0.02)	P-3435 Almond
USA, CA, 1999 Farmersville	WP	0.22, 0.11, 0.22, 0.11, 0.11	5	7	< 0.05,< 0.05	
USA, CA, 1999 Porterville	WP	0.22, 0.11, 0.22, 0.11, 0.11	5	7	< 0.05,< 0.05	
USA, CA, 1999 Madera	WP	0.11, 0.06, 0.11, 0.06, 0.06	5	6	< 0.05,< 0.05	
USA, CA, 1999 Chico	WP	0.11	5	7	< 0.05,< 0.05	

Oilseed

Table 71 Bifenthrin residues in cotton seed

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha (kg ai/hL)	No			
Brazil, 2004 Campinas	EC	0.08	1	15	< 0.02	BR254
	EC	0.16	1	15	< 0.02	
Brazil, 2004 Goiana	EC	0.08	5	15	0.02	BR308
	EC	0.16	5	15	0.02	
Brazil, 2004 Rondonopolis	EC	0.08	5	15	0.07	BR310
	EC	0.16	5	15	0.2	
Brazil, 2005 Paranapanema	EC	0.1	10	15	< 0.02	BR356
	EC	0.2	10	15	< 0.02	
Brazil, 2005 Guaira	EC	0.1	10	15	< 0.02	BR357
	EC	0.2	10	15	< 0.02	

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha (kg ai/hL)	No			
Brazil, 2005 Leme	EC	0.1	10	15	< 0.02	BR358
	EC	0.2	10	15	< 0.02	
Greece, 2004	SC	0.05 (0.016)	2	21	< 0.01	686183
Greece, 2004	EC	0.055 0.057 (0.018)	2	21	< 0.01	
Greece, 2005	SC	0.051 (0.017) 0.052 (0.017) 0.076 (0.026)	3	14 21 152	< 0.01 < 0.01 < 0.01	686199
Greece, 2005	EC	0.05 (0.017)	2	0 2 4 7 10 14 21	< 0.01 < 0.01 < 0.01 < 0.01 < 0.01 < 0.01 < 0.01	
Spain, 2005	SC	0.051 (0.016) 0.051 (0.016) 0.078 (0.026)	3	14 22 154	< 0.01 < 0.01 < 0.003	686199
Spain, 2005	EC	0.056 (0.018) 0.054 (0.018)	2	0 2 4 7 10 14 21	0.016 0.011 < 0.01 < 0.01 < 0.01 0.011 < 0.003	
Spain, 2004	SC	0.05 0.049 (0.018)	2	21	< 0.01	686183
Spain, 2004	EC	0.05 0.05	2	21	< 0.01	
Spain, 1983 Sevilla	EC	0.38	5	25	< 0.02, < 0.02, < 0.02	FCC 61
	EC	0.32	5	25	< 0.02, < 0.02	
South Africa, 1985	EC	0.1	1	35	< 0.05, 0.05	311/88720/BI24
	EC	0.2	1	35	< 0.05, 0.05	
USA, CA, 1983 Brawley	EC	0.1	10	14	0.06, < 0.05 (0.02)	RAN-0135
USA, TX, 1983 Uvalde	EC	0.1	10	14	< 0.05, < 0.05	
USA, Ark, 1983 Marion	EC	0.1	10	14	< 0.05 (0.04, 0.04)	
USA, NC, 1983 Clayton Treated 16-Aug-83	EC	0.1	11	14	< 0.05 (0.04, 0.02)	
USA, NC, 1983 Clayton Treated 03-Oct-83	EC	0.1	4	14	< 0.05	
USA, AL, 1983 Montgomery	EC	0.1	10	14	0.11, 0.17	
USA, CA, 1983 Kerman Treated 11-Jul-83 to 03-Oct-83	EC	0.1	11	14	0.09, 0.13	

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha (kg ai/hL)	No			
USA, CA, 1983 Kerman Treated 29-Jul-83 to 03-Oct-83	EC	0.1	10	14	0.06, 0.07	
USA, AZ, 1983 Phoenix	EC	0.1	10	14	0.33, 0.37	
USA, CA, 1983 Winterhaven	EC	0.1	10	14	< 0.05, < 0.05	
USA, MS, 1984 Grace	EC	0.1	10	14	0.06, < 0.05 (0.04)	RAN-0154
USA, MS, 1984 Glan Allan	EC	0.1	10	14	< 0.05 (0.03, 0.04)	
USA, AZ, 1984 Somerton	EC	0.1	11	14	< 0.05 (0.02, 0.01)	
USA, AL, 1984 Montgomery	EC	0.1	10	14	< 0.05 (0.02, 0.02)	
USA, AL, 1984 Montgomery	EC	0.1	10	14	0.07, < 0.05 (0.04)	
USA, CA, 1984 Westmorland	EC	0.1	11	14	< 0.05 (0.02, 0.01)	
USA, AZ, 1984 Litchfield Park	EC	0.17	7	14	< 0.05 (0.03, 0.03)	RAN-0155
USA, AZ, 1984 Litchfield Park	EC	0.22	7	14	< 0.05, < 0.05	
USA, CA, 1984 El Centro	EC	0.17	7	14	0.12, 0.07	
USA, CA, 1984 El Centro	EC	0.22	5	14	0.06, 0.06	
USA, TX, 1985 Uvalde	EC	0.11	10	14	< 0.05 (0.03, 0.02)	RAN-0184
USA, CA, 1985 Imperial	EC	0.11	10	14	< 0.05 (0.04), 0.06	
USA, MS, 1985 Wayside	EC	0.11	10	14	< 0.05 (0.04), 0.05	
USA, CA, 1993 Reedley	WP	0.11	3	14	< 0.05, < 0.05	P-2902
USA, CA, 1993 Hanford	WP	0.11	3	14	< 0.05, < 0.05	

Table 72 Bifenthrin residues in rape seed

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
Canada, 1996 Minto	EC	0.04	2	20	< 0.05 (0.029, 0.026)	IR-4 PR No. 06057
Canada, 1996 Boissevain	EC	0.04	2	29	< 0.05 (0.026, 0.019)	
Germany, 2001 Hahausen	SC	0.01	2	50 56	< 0.01, 0.01 < 0.01	20011318/01-RRA
Germany, 2001 Pfaffroda	SC	0.01	2	56 63	< 0.01, 0.016 < 0.01, 0.03	
Germany, 2001 Kottmannsweiler	SC	0.01	2	56 65	< 0.01, 0.022 < 0.01, 0.03	
Germany, 2001 Obersteinach	SC	0.01	2	56 63	< 0.01 < 0.01	
Germany, 2002 Hahausen	SC	0.01	2	55 63	< 0.01 < 0.01	20011318/02-RRA
Germany, 2002 Pfaffroda	SC	0.01	2	56 63	< 0.01 < 0.01	
Germany, 2002 Schwabisch Hall	SC	0.01	2	55 62	< 0.01 < 0.01	

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
Germany, 2002 Kottmannsweiler	SC	0.01	2	56 62	< 0.01 < 0.01	
Poland, 1985	EC	0.02	1	52	< 0.01	FMC Pol-1986 No information on method available
Poland, 1985	EC	0.025	1	52	< 0.01	
UK, 1984 Mountnessing	EC	0.024	2	177	< 0.02, < 0.02	FCC 66/3 LOD 0.02 mg/kg, no LOQ provided
UK, 1984 Hallingbury	EC	0.024	2	166	< 0.02, < 0.02	
UK, 1984 Doddinghurst	EC	0.024	2	171	< 0.02, < 0.02	
UK, 1986 Faversham	EC	0.02	2	18 46	< 0.01, < 0.01 < 0.01, < 0.01	73/61 LOD 0.01 mg/kg, Recovery at 0.01 mg/kg 106%
UK, 1986 Barfield	EC	0.02	2	14 38	< 0.01, < 0.01 < 0.01, < 0.01	
USA, WA, 1996 Moxee	EC	0.04	2	21	< 0.05 (0.019, 0.019)	IR-4 PR No. 06057
	EC	0.04	2	21	< 0.05 (0.017, 0.026)	
USA, Ga, 1996 Ty Ty	EC	0.04	2	27	< 0.05, < 0.05	
USA, ND, 1996 Langdon	EC	0.04	2	28	< 0.05 (0.034, 0.035)	
USA, ND, 1996 Carrington	EC	0.04	2	29	< 0.05 (0.036, 0.028)	

Legume animal feed

Table 73 Bifenthrin residues in pea hay or fodder

Country, year, location	Application			PHI, days	Residues, mg/kg	Report
	Form	kg ai/ha	No			
Denmark, 1986	EC	0.0075	1	35	0.12, 0.18, 0.06, 0.10	FCC 115(a)
Germany, 2001 Kupferzell	SC	0.01	2	35 42	0.035 0.032	
Germany, 2001 Pfaffroda	SC	0.01	2	37 44	0.18 0.12	
Germany, 2001 Kummer	SC	0.01	4	49 56	0.10 0.11	
Germany, 2001 Lutter	SC	0.01	4	48 55	0.083 0.039	
Germany, 2002 Grimmitschau	SC	0.01	2	14	0.34	20011318/02-RPS
Germany, 2002 Seesen	SC	0.01	2	14	0.094	
UK, 2002 Turkdean	SC	0.01	2	15	0.24	20021228/GB1-FPPS
UK, 2002 Stratton Audley	SC	0.01	2	15	0.14	
UK, 2002 Harrington	SC	0.01	2	14	0.06	
UK, 2002 Baumber	SC	0.01	2	14	0.035	
UK, 2002 Stratford	SC	0.01	2	14	0.07	
UK, 2002 Thimbleby	SC	0.01	2	13	0.033	

Table 74 Bifenthrin residues in pea vines (green)

Country, Year, location	Application			PHI,	Residue, mg/kg	Report
	Form	Kg ai/ha	No	days		
Denmark, 1986	EC	0.0075	1	0 14 22	0.06, 0.06 < 0.02, < 0.02 < 0.02, < 0.02 < 0.02, < 0.02	FCC 115(a) LOD 0.02 mg/kg, no information on LOQ
France, 1990	EC	0.0075	1	0 4 7 16 36	0.6 0.14 0.02 0.005 < 0.005	91-515 LOD 0.005 mg/kg, no information on LOQ
France, 2001 Annoire	SC	0.02	2	7	0.48	BKA/691/01/RES
France, 2001 Allery	SC	0.02	2	7	0.23	
Belgium, 2001 Kortenaken Variety Giroy	SC	0.02	2	7	0.69	
Belgium, 2001 Kortenaken Variety Lynx	SC	0.02	2	7	0.77	
Germany, 2001 Kupferzell Treated BBCH 67	SC	0.01	2	0 3 7 8	0.11, 0.11 0.11, 0.057 0.071 0.11	20011318/01-RPS
Germany, 2001 Kupferzell Treated BBCH 71	SC	0.01	2	10 15	0.037 0.051	20011318/01-RPS
Germany, 2001 Pfaffroda Treated BBCH 69	SC	0.01	2	0 3 7 10 14	0.019, 0.027 0.089, 0.096 0.057, 0.11 0.075 0.078	20011318/01-RPS
Germany, 2001 Kummer Treated BBCH 75	SC	0.01	2	7 14	0.10 0.055	20011318/01-RPS
Germany, 2001 Lutter	SC	0.01	2	8 15	0.022 < 0.01 (0.007)	20011318/01-RPS
Hungary, 2003	EC	0.02	2	7	0.39, 0.35, 0.33	03 FMC AB 1701
Poland, 1989		0.01	5	0 8 12	0.24 0.06 0.05	BI 13.1.6/16
UK, 2002 Harrington	SC	0.010	2	7	0.084	20021228/GB1-FPPS
UK, 2002 Baumber	SC	0.010	2	7	0.11	
UK, 2002 Stratford	SC	0.010	2	0 3 5 7	0.13 0.20 0.13 0.14	
UK, 2002 Thimbleby	SC	0.010	2	0 3 5 7	0.17 0.12 0.11 0.13	20021228/GB1-FPPS

Straw, fodder and forage of cereals

Table 75 Bifenthrin residues in barley straw

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
Denmark, 1986	EC	0.0075	1	37	0.36, 0.45	FCC 115(a)
Finland, 1986	EC	0.0075	2	46	0.03	13.1.1/3 information on LOQ not provided
Finland, 1986	EC	0.01	1	60	< 0.02	
France, 2003, Les Cheres	SC	0.008	2	28	0.23	20031328/01-RCE
France, 2003, Joyeux	SC	0.008	2	27	0.26	
France, 2007, Montauban	SC	0.01	2	33	0.09	20074083/E1-FPWB
France, 2007, Montfermier	SC	0.01	2	37	0.23	
Germany, 1992, Giggenhausen	SC	0.008	1	35	0.15, 0.15	NA 92 1274
Germany, 1992, Ismaning	SC	0.008	1	35	0.17, 0.23	NA 92 1274
Germany, 2001, Kottmansweiler, Variety Regina	SC	0.0075	2	35 41	0.20 0.18	20011318/01-RWB
Germany, 2001, Weidensdorf	SC	0.0075	2	35 43	0.11 0.085	
Germany, 2001, Kottmannsweiler, Variety Duett	SC	0.0075	2	35 42	0.18 0.21	20011318/02-RWB
Germany, 2002, Riedback	SC	0.0075	2	35 41	0.20 0.16	20011318/01-RSBA
Germany, 2002, Blumenhagen	SC	0.0075	2	36 41	0.097 0.11	20011318/01-RSBA
Germany, 2002, Ebersheim	SC	0.008	2	42	0.11	20021228/E1-FPCE
Greece, 2007, Melissohori	SC	0.01	2	35	0.21	20074083/E1-FPWB
Greece, 2007, Akropotamia	SC	0.01	2	35	0.11	
Italy, 2007, Conselice	SC	0.01	2	29	0.47	20074083/E1-FPWB
Italy, 2007, Grandola	SC	0.01	2	31	0.27	
Poland, 2007, Kluczewo	SC	0.01	2	35	0.24	20074083/E1-FPWB
Poland, 2007, Otoworo	SC	0.01	2	34	0.17	
UK, 1984, Snifnal	EC	0.005	2	179	< 0.2	FCC 66/4
UK, 1984, Salisbury	EC	0.005	2	128	< 0.2 (0.04)	
UK, 1984, Cressing	EC	0.005	2	158	< 0.2	
UK, 1985, Blackmere	EC	0.0075	2	177	< 0.01, < 0.01	73/48 II LOQ 0.01 mg/kg for straw
UK, 1985, Dorchester	EC	0.0075	2	169	< 0.01, < 0.01	
UK, 1985, W. Hesleton	EC	0.0075	2	192	< 0.01, < 0.01	

Table 76 Bifenthrin residues in maize straw

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
France, 2004	SC	0.105	1	178	< 0.01	20041181/E1-FPMA
Hungary, 2004	SC	0.116	1	145	< 0.01	
USA, TX, 1984 La Feria	EC	0.11	5	38	1.1, 1.3	RAN-0152
USA, IN, 1984 Mt. Vernon	EC	0.11	5	43	0.76, 1.0	
USA, IN, 1984 Mt. Vernon Last 3 appl aerial	EC	0.11	5	43	2.9, 1.4	
USA, MO, 1984 Charleston	EC	0.11	5	68	0.74, 1.6	
USA, TX, 1984 Tulia	EC	0.11	5	50	< 0.5 (0.12, 0.17)	
USA, IL, 1984 Champaign	EC	0.11	5	56	< 0.5 (0.47), 0.68	

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
USA, TX, 1984 Dalhart	EC	0.11	5	45	1.2, 0.73	
USA, CO, 1984 Wray Last 3 apps.aerial	EC	0.11	5	60	0.50, < 0.5 (0.47)	
USA, CO, 1984 Wray	EC	0.11	5	60	1.1, 1.1	
USA, NY, 1984 Phelps	EC	0.11	5	64	2.8, 3.0	
USA, CA, 1984 Turlock	EC	0.11	5	60	2.9, 3.1	
USA, CA, 1986	EC	0.11	5	30	2.7, 0.66	P-1645
		0.11, 0.11, 0.11, 0.11, 0.11, 1.1	6	31	< 0.5 (0.38), 2.5	
USA, AL, 1986	EC	0.11	5	31	1.7, 1.7	
USA, NE, 1986	EC	0.11	5	33	1.6, 2.0	
USA, PA, 1986	EC	0.11	5	65	0.50, 0.64	
		0.11, 0.11, 0.11, 0.11, 1.1	5	65	12, 11	
USA, OH, 1987	EC	0.11	5	39	1.6, 1.9	P-2547 P-2550 analysis
USA, TX, 1987	EC	0.11	5	46	< 0.5, < 0.5	
USA, CA, 1987	EC	0.11	5	54	< 0.5 (0.27, 0.26)	
USA, IA, 1987	EC	0.11	5	49	2.5, 0.55	
USA, IL, 1987	EC	0.11	5	29	< 0.5, < 0.5	
USA, MN, 1987	EC	0.11	5	35	4.6, 3.0	
USA, NY, 1987	EC	0.11	5	47	1.5, 1.3	
USA, OH, 1987	EC	0.11, 0.11, 0.11, 0.11, 1.1	5	39	19, 19	P-2548 P-2550 analysis
USA, CA, 1987	EC	0.11, 0.11, 0.11, 0.11, 1.1	5	54	2.3, 2.2	
USA, IL, 1987	EC	0.11, 0.11, 0.11, 0.11, 1.1	5	33	10, 10	
USA, PA, 1987	EC	0.11	5	55	1.1, 1.4	P-2549 P-2550 analysis
USA, WI, 1987	EC	0.11	5	30	0.20, < 0.2	
USA, PA, 1996 Germansville	EC	0.09, 0.09, 0.04	3	39	2.1, 1.8	RAN-0295
USA, PA, 1996 Hamburg	EC	0.09, 0.09, 0.04	3	50	0.68, 0.84	
USA, NC, 1996 Creedmore	EC	0.09, 0.09, 0.04	3	54	0.98, 1.2	
USA, NC, 1996 Lucama	EC	0.09, 0.09, 0.04	3	28	3.3, 2.1	
USA, FL, 1996 Bascom	EC	0.09, 0.09, 0.04	3	42	1.5, 1.9	
USA, MI, 1996 Williamstone	EC	0.09, 0.09, 0.04	3	16	1.4, 1.6	
USA, IL, 1996 Wyoming	EC	0.09, 0.09, 0.04	3	38	1.5, 1.4	
USA, IA, 1996 Webster City	EC	0.09, 0.09, 0.04	3	36	1.6, 1.2	
USA, IA, 1996 Bedford	EC	0.09, 0.09, 0.04	3	33	1.1, 1.1	
USA, IN, 1996 Nobelsville	EC	0.09, 0.09, 0.04	3	29	3.4, 2.5	
USA, IN, 1996 Sheridan	EC	0.09, 0.09, 0.04	3	30	1.3, 1.5	
USA, CA, 1996 Madera	EC	0.09, 0.09, 0.04	3	35	1.2, 1.4	
USA, ID, 1996 Minidoka	EC	0.09, 0.09, 0.04	3	51	0.75, 0.57	

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
USA, IL, 2002	EC	0.11, 0.06, 0.06, 0.06, 0.06	5	1 3 7 14	1.1, 1.4 0.82, 0.59 0.65, 0.32 0.37, 0.31	P-3593
USA, NE, 2002	GR, EC	0.11, 0.06, 0.06, 0.06, 0.06	5	1 3 7 15	1.1, 0.95, 0.78, 0.64, 0.45, 0.41 0.43, 0.35	

Table 77 Bifenthrin residues in oats straw

Country, year, location	Application			PHI, Days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
France, 2002	SC	0.008	2	41	0.074	20021228/E1-FPCE
UK, 2002	SC	0.007-0.008	2	41	0.059	

Table 78 Bifenthrin residues in triticale straw

Country, year	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
Germany, 2001	SC	0.008	2	34 43	0.12 0.15	20011318/01-RTR
UK, 2002	SC	0.007	2	43	0.069	20021228/E1-FPCE

Table 79 Bifenthrin residues in wheat straw

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
Australia, 1996	EC	0.01	1	142	< 0.01	96/0798
Australia, 1996	EC	0.02	1	145	< 0.01	
Denmark, 1986	EC	0.075	1	37	0.38, 0.38	FCC 115(a)
France, 1984 Adonville	EC	0.008	1	58	0.09	FCC 67/3
		0.01	1	58	0.08	
France, 1984 Atraps	EC	0.008	1	57	0.07	
		0.01	1	57	0.11	
France, 1984 Vendin-le-Vieil	EC	0.008	1	64	0.28	FCC 67/2
		0.01	1	64	0.27	
France, 1984 Chippilly	EC	0.008	1	69	0.12	
		0.01	1	69	0.18	
France, 1984 Le Hamel	EC	0.008	1	69	0.12	
		0.01	1	69	0.14	
France, 1985 Vignacourt	EC	0.0063	1	8 14	0.07 0.11	FCC 93
France, 2003	SC	0.008 0.008	2 2	27 28	0.17 0.28	20031328/01-RCE
France, 2007 Montauban	SC	0.01	2	35	0.43	20074083/E1-FPWW
France, 2007 Notre Dame de la Croix	SC	0.01	2	35	0.15	
France, 2009 Romanswiller	SC	0.01	2	35	0.35	S09-00398
France, 2009 Rouvres-St.-Jean	SC	0.01	2	35	0.35	
Germany, 1992 Landsberg, Variety Ares	SC	0.008	1	61	0.04, 0.034	NA 92 1274

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
Germany, 1992 Landsberg, Variety Orestis	SC	0.008	1	52	0.073, 0.075	
Germany, 2001 Riedbach	SC	0.0075	2	35 41	0.12 0.18	20011318/02-RWW
Germany, 2001 Kottmansweiler	SC	0.0075	2	35 42	0.13 0.11	20011318/01-RWW
Germany, 2001 Lutter	SC	0.0075	2	35 42	0.061 0.11	
Germany, 2002 Riedback	SC	0.0077	2	35 42	0.05 0.20	20011318/01-RSWH
Germany, 2002 Jahnsdorf	SC	0.0078	2	35 42	0.19 0.24	
Germany, 2009	SC	0.01	2	35	0.20	S09-00398
Greece, 2007 Kilkis, Variety Mesapia	SC	0.01	2	34	0.11	20074083/E1-FPWW
Greece, 2007 Kilkis, Variety Bronde	SC	0.01	2	34	0.27	
Hungary, 2007	SC	0.01	2	33	0.14	
Italy, 2007 Concelice	SC	0.01	2	35	0.30	
Italy, 2007 Budrio	SC	0.01	2	30	0.43	
Italy, 2009	SC	0.01	2	35	0.32	S09-01173
Poland, 2007	SC	0.01	2	35	0.17	20074083/E1-FPWW
Spain, 2009	SC	0.01	2	35	0.11	S09-01173
UK, 2002	SC	0.003	2	43	0.24	20021228/E1-FPCE
UK, 2009	SC	0.01	2	62	0.51	S09-00398

Table 80 Bifenthrin residues in barley forage

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
Germany, 1992 Giggenhausen	SC	0.008	1	0	0.15, 0.17	NA 92 1274
Germany, 1992 Ismaning	SC	0.008	1	0	0.16, 0.18	
Germany, 2001 Kottmannsweiler Variety Regina	SC	0.0075	2	0 8 15 28	0.11 0.064 0.065 0.16	20011318/01-RWB
Germany, 2001 Kottmannsweiler Variety Duett	SC	0.0075	2	0 7 14 28	0.11 0.054 0.057 0.30	20011318/02-RWB
Germany, 2002 Riedback	SC	0.0075	2	0 7 15 29	0.14 0.075 0.071 0.16	20011318/01-RSBA
Germany, 2002 Blumenhagen	SC	0.0075	2	0 6 13 27	0.13 0.043 0.055 0.057	20011318/01-RSBA
Germany, 2002 Ebersheim	SC	0.008	2	35	0.17	20021228/E1-FPCE

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
Denmark, 1986	EC	0.0075	1	0 14 29	0.26, 0.32 0.09, 0.11 0.11, 0.11	FCC 115(a)

Table 81 Bifenthrin residues in maize forage

Country, year, location	Application			PHI, days	Residues, mg/kg	Report
	Form	kg ai/ha	No			
France, 1987 Genas	EC	0.02	1	62	< 0.01, < 0.01	73/74 LOD 0.01 mg/kg
France, 1987 Coulmiers	EC	0.02	1	63	0.01, 0.03, 0.03, 0.04	
France, 2004 Versailleux	SC	0.105	1	83 104	< 0.01 < 0.01	20041181/E1-FPMA LOQ 0.01 mg/kg LOD 0.003 mg/kg
Hungary, 2004	SC	0.116	1	95 100	< 0.01 < 0.01	
Hungary, 2003	EC	0.033	1	7	0.50, 0.50, 0.56	03 FMC AA 1702
Italy, 2002	SC	0.02	1	7	0.059	B14/MA
USA, TX, 1984 La Feria	EC	0.11	5	30	0.83, 1.4	RAN-0152
USA, IN, 1984 Mt. Vernon Last 3 apps.aerial	EC	0.11	5	30	0.94, 1.3	
USA, IN, 1984 Mt.Vernon	EC	0.11	5	30	0.57, 0.97	
USA, MO, 1984 Charleston	EC	0.11	5	30	0.55, 0.43	
USA, TX, 1984 Tulia	EC	0.11	5	30	0.10, 0.16	
USA, IL, 1984 Champaign	EC	0.11	5	30	0.30, 0.49	
USA, TX, 1984 Dalhart	EC	0.11	5	30	0.55, 0.60	
USA, NC, 1984 Yadkinville	EC	0.11	5	15	1.5, 0.66	
USA, CO, 1984 Wray Last 3 apps aerial	EC	0.11	5	31	< 0.05, 0.29	
USA, CO, 1984 Wray	EC	0.11	5	31	0.48, 0.76	
NY, USA, 1984 Phelps	EC	0.11	5	29	1.6, 1.3	
USA, CA, 1984 Turlock	EC	0.11	5	30	2.0, 1.7	
USA, CA, 1986 Holtville	EC	0.11	5	10	0.30, 0.60	P-1645
USA, AL, 1986 Montgomery	EC	0.11	5	31	0.88, 0.97	
USA, NE, 1986 York	EC	0.11	4	24	0.23, 0.22	
USA, PA, 1986 Dillingersville	EC	0.11	5	30	0.49, 0.45	
		0.11, 0.11, 0.11, 0.11, 1.1	5	30	4.0, 4.5	
USA, OH, 1987 St. Paris	EC	0.11	5	14	1.2, 0.92	P-2547/P-2550 rev
USA, TX, 1987 Batesville	EC	0.11	4	42	< 0.1, < 0.1	
USA, CA, 1987 Holtville	EC	0.11	5	15	0.23, 0.29	
USA, IL, 1987 Utica	EC	0.11	3	31	< 0.1 (0.07), 0.14	

Country, year, location	Application			PHI, days	Residues, mg/kg	Report
	Form	kg ai/ha	No			
USA, MN, 1987 Lamberton	EC	0.11	3	30	0.85, 0.12	
USA, NY, 1987 Phelps	EC	0.11	5	30	0.40, 0.57	
USA, OH, 1987 St. Paris	EC	0.11, 0.11, 0.11, 0.11, 1.1	5	14	9.2, 11	P-2548/P-2550 rev
USA, CA, 1987 Holtville	EC	0.11, 0.11, 0.11, 0.11, 1.1	5	15	1.4, 1.7	
USA, IL, 1987 Champaign	EC	0.11, 0.11, 0.11, 0.11, 1.1	4	32	0.28, 0.24	
USA, PA, 1987 Germansville	EC	0.11	4	15	0.39, 0.37	P-2549/P-2550 rev
USA, WI, 1987 Poynette	EC	0.11	4	31	0.23, < 0.1	
USA, PA, 1996 Germansville	EC	0.09, 0.09, 0.04	3	1	1.5, 1.8	RAN-0295
USA, PA, 1996 Hamburg	EC	0.09, 0.09, 0.04	3	1	1.5, 2.0	
USA, NC, 1996 Creedmore	EC	0.09, 0.09, 0.04	3	1	1.9, 2.4	
USA, NC, 1996 Lucama	EC	0.09, 0.09, 0.04	3	1	1.6, 1.9	
USA, FL, 1996 Bascom	EC	0.09, 0.09, 0.04	3	1	2.3, 2.7	
USA, MI, 1996 Williamstone	EC	0.09, 0.09, 0.04	3	1	2.0, 2.3	
USA, IL, 1996 Wyoming	EC	0.09, 0.09, 0.04	3	1	1.4, 1.8	
USA, IA, 1996 Webster City	EC	0.09, 0.09, 0.04	3	1	2.3, 2.8	
USA, IA, 1996 Bedford	EC	0.09, 0.09, 0.04	3	1	1.6, 1.8	
USA, IN, 1996 Noblesville	EC	0.09, 0.09, 0.04	3	1	1.9, 2.1	
USA, IN, 1996 Sheridan	EC	0.09, 0.09, 0.04	3	1	1.8, 1.8	
USA, CA, 1996 Madera	EC	0.09, 0.09, 0.04	3	1	1.7, 1.5	
USA, ID, 1996 Minidoka	EC	0.09, 0.09, 0.04	3	1	1.1, 1.7	
USA, IL, 2002 Wyoming	EC	0.11, 0.06, 0.06, 0.06, 0.06	4	1 3 7 14	0.31, 0.32 0.41, 0.31 0.24, 0.30 0.24, 0.11	P-3593
USA, NE, 2002 York	GR, EC	0.11, 0.06, 0.06, 0.06, 0.06	4	1 3 7 15	0.39, 0.40 0.29, 0.25 0.15, 0.16 0.12, 0.12	

Table 82 Bifenthrin residues in oats forage

Country, year	Application			PHI, days	Residues, mg/kg	Report
	Form	kg ai/ha	No			
France, 2002	SC	0.008	2	35	0.024	20021228/E1/FPCE
UK, 2002	SC	0.007-0.008	2	35	0.041	

Table 83 Bifenthrin residues in triticale forage

Country, year	Application			PHI, days	Residue mg/kg	Report
	Form	kg ai/ha	No			
UK, 2002	SC	0.007	2	34	0.068	20021228/E1/FPCE

Table 84 Bifenthrin residues in wheat forage

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
Australia, 1996	EC	0.01	1	29 70	0.01 < 0.01	96/0798
Australia, 1996	EC	0.02	1	29 70	0.02 < 0.01	
Denmark, 1986	EC	0.075	1	0 14 28	0.16, 0.16 0.09, 0.11 0.14, 0.19	FCC 115(a)
France, 2009 Romanswiller	SC	0.01	2	22	0.27	S09-00398
France, 2009 Rouvres-St.-Jean	SC	0.01	2	0 21	0.16 0.32	
Germany, 1992 Landsberg Variety Ares	SC	0.008	1	0 13	0.16, 0.16 0.058, 0.063	NA 92 1274
Germany, 1992 Landsberg Variety Orestis	SC	0.008	1	0 10	0.15, 0.17 0.073, 0.089	
Germany, 2001 Riedbach	SC	0.0075	2	-0 +0 7 15 29	0.06 0.16 0.10 0.085 0.12	20011318/02-RWW
Germany, 2001 Kottmannsweiler	SC	0.0075	2	-0 +0 7 13 27	0.013 0.14 0.048 0.044 0.12	20011318/01-RWW
Germany, 2002 Riedbach	SC	0.0077	2	-0 +0 7 14 28	0.024 0.17 0.049 0.051 0.15	20011318/0-RSWH
Germany, 2002 Jahnsdorf	SC	0.0078	2	-0 +0 7 14 28	0.031 0.17 0.061 0.11 0.11	
Germany, 2009	SC	0.01	2	0 21	0.22 0.18	S09-00398
Italy, 2009	SC	0.01	2	-0 +0 21	0.13 0.25 0.20	S09-01173
Spain, 2009	SC	0.01	2	-0 +0 22	0.05 0.20 0.21	
UK, 2002	SC	0.003	2	36	0.024	20021228/ E1-FPCE
UK, 2009 North Cave, Variety Robicus	SC	0.01	2	19 36	0.23 0.14	S09-00398
UK, 2009 North Cave, Variety Consort	SC	0.01	2	0 19	0.20 0.33	
UK, 2009	SC	0.01	2	0	0.19	

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
North Cave, Variety Oakley				19	0.40	

Miscellaneous fodder and forage crops

Table 85 Bifenthrin residues in almond hulls

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
USA, CA, 1999, Lemoore	WP	0.22, 0.11, 0.22, 0.11, 0.11	5	7	1.9, 2.0	P-3435
USA, CA, 1999, Farmersville	WP	0.22, 0.11, 0.22, 0.11, 0.11	5	7	0.84, 0.84	
USA, CA, 1999, Portersville	WP	0.22, 0.11, 0.22, 0.11, 0.11	5	7	1.6, 1.6	
USA, CA, 1999, Madera	WP	0.11, 0.06, 0.11, 0.06, 0.06	5	6	0.83, 0.74	
USA, CA, 1999, Chico	WP	0.11	5	7	1.5, 1.4	

Table 86 Bifenthrin residues in rape forage

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
Germany, 1986 Oberpfaffenhofen	EC	0.04	4	0 42	< 0.01 0.01	73/67
Germany, 1986 Freiham	EC	0.04	4	0 42	0.17 < 0.01	
Germany, 1986 Schleswig	EC	0.04	4	0 42	0.18, 0.15, 0.28 < 0.01, < 0.01,< 0.01	
Germany, 2001 Hahausen	SC	0.01	2	0 21	0.055 0.019	20011318/01-RRA
Germany, 2001 Kottmannsweiler	SC	0.01	2	0 21	0.074 0.013	

Table 87 Bifenthrin residues in sugar beets, leaves and tops

Country, year, location	Application			PHI, days	Residue, mg/kg	Report
	Form	kg ai/ha	No			
France, 1998 Stattmatten	SC	0.024	2	28	0.094	13.1.3/4
France, 1998 Seebach	SC	0.024	2	30	0.17	
France, 1998 Barly	EC	0.03	2	0 8 14 29	0.50 0.25 0.20 0.10	13.1.3/5
France, 1998 Saint Bernard	EC	0.03	2	0 8 14 28	0.68 0.40 0.30 0.20	
France, 1999 Cardonette	EC	0.03	2	28	0.23	13.1.3/7
France, 1999 Crimolois	EC	0.03	2	28	0.38	

Dried herbs

Table 88 Bifenthrin residues in hops

Country, year, location	Application			PHI, days	Residues, mg/kg		Report
	Form	kg ai/ha	No		fresh	dry	
USA, WA, 1989	WP	0.11	3	14 21 28	0.39, 0.23 0.17, 0.21, 0.19 0.38, 0.18	0.85, 0.53, 0.40 0.55, 0.33 0.73, 0.32	IR-4 PR No. 3949
USA, ID, 1989	WP	0.11	3	14 21 28	0.42, 0.56 0.42, 0.43 0.49, 0.60	1.1, 1.2 0.85, 0.93 1.9, 1.6	
USA, OR, 1989	WP	0.11	3	14	1.9, 1.1, 1.1, 0.46	5.4, 5.1, 5.4, 4.3, 4.6	
				21	1.0, 1.3	3.1, 3.2, 2.9, 2.9, 2.9, 3.6	
				28	0.99, 0.98	4.1, 3.8, 3.8, 4.8, 3.4, 3.7, 4.1	
Germany, 1984 Tettnager	EC	0.12	5	0 3 5 7 10		3.6 2.1 0.50 1.2 1.9	73/44
Germany, 1984 Pilschdorf Variety North. Brewer	EC	0.12	5	0 3 5 7 10		4.8 3.1 2.5 1.8 1.9	
Germany, 1984 Pilschdorf Variety Herbrucker	EC	0.12	5	0 3 5 7 10		0.70 0.30 2.0 0.30 0.70	
Germany, 1984 Spalter	EC	0.12	5	0 3 5 7 10		6.4 7.2 4.1 4.9 2.9	
Germany, 1985 Tettnager	EC	0.12	4	0 3 5 7 10		2.3 2.5 1.6 1.5 0.80	73/52
Germany, 1985 Pilschdorf Variety North. Brewer	EC	0.12	4	0 3 5 7 10		7.3, 9.0 0.8, 2.1 9.5, 8.4 7.3, 8.9 0.10, 0.10	
Germany, 1985 Spalter	EC	0.12	4	0 3 5 7 10		2.2 4.0 2.5 1.7, 1.1 0.9	
Germany, 1985 Pilschdorf, Variety Hersbrucker	EC	0.12	4	0 3 5 7 10		2.2, 3.4 2.7 1.5 1.1 4.3, 4.1	
Germany, 1987 Pilschdorf Variety Gold Treated 01-Sep-87	EC	0.1	5	0 3 5 7 10	3.1 1.9 1.4 0.90 1.6	-- -- -- 1.6 2.5	73/72/B
	EC	0.1	5	0 3 5 7 10	2.8 1.7 1.6 0.94 1.6	-- -- -- 1.6 2.7	

Country, year, location	Application			PHI, days	Residues, mg/kg		Report
	Form	kg ai/ha	No		fresh	dry	
Germany, 1987 Pilschdorf Variety North. Brewer Treated 24-Aug-87	EC	0.1	5	0 3 5 7 10	1.2 0.92 0.50 0.92 0.28	-- -- -- 2.1 1.0	
	EC	0.1	5	0 3 5 7 10	1.4 0.59 1.3 0.79 1.1	-- -- -- 2.3 1.9	
UK, 1987	EC	0.036-0.088	8	20		2.4, 2.8, 2.0, 2.2	
UK, 1986	EC	0.022	4	42		0.22	73/56
UK, 1986	EC	0.022	1	7		0.61	
UK, 1993 Stretton	EC	0.09	5	0 7		5.2, 6.0, 5.4 6.4, 5.3, 3.5	FCC 0693
UK, 1993 Knightwick	EC	0.09	5	0 7		3.5, 4.2, 6.0 3.1, 2.8, 1.9	
UK, 1993 Bishops Frome	EC	0.09	5	0 7		6.0, 6.2, 6.5 6.5, 4.9, 5.0	
UK, 1993 Sheldwich	EC	0.09	5	0 7		7.4, 5.9, 7.0 4.9, 4.2, 4.4	
UK, 1993 Nettlestead	EC	0.09	5	0 7		5.4, 4.4, 5.9 4.6, 3.8, 3.8	

Teas

Table 89 Bifenthrin residues in tea

Country, year, location	Application			PHI, days	Residues, mg/kg		Report
	Form	kg ai/ha	No		fresh	dry	
China, 1984 Hangzhou	EC	0.023	1	0 1 4 7 10 14 17 20	14 14 5.7 3.2 2.8 0.17 0.67 0.45	13 13 4.8 3.1 1.9 1.0 0.38 0.47	13.3.9/8
China, 1984 Chengsa	EC	0.023	1	0 1 4 7 10 14 17	- 14 4.3 3.0 2.6 0.59 0.18	9.6 7.8 2.4 2.4 1.3 0.33 0.15	
China, 1984 Chengsa Latest harvest 12-Jul-84	EC	0.045	1	0 1 4 7 10 14 17 20	30 15 7.2 3.7 2.5 1.0 0.64 0.66	24 13 6.8 <u>4.3</u> 2.3 1.1 0.70 0.70	
China, 1984 Chengsa Latest harvest 03-Sep-84	EC	0.045	1	0 1 4 7 10 14 17 20	17 7.2 2.3 1.5 0.94 0.32 0.16 0.03	11 5.4 4.3 <u>1.2</u> 0.92 0.12 0.05 0.03	13.3.9/8

Country, year, location	Application			PHI, days	Residues, mg/kg		Report
	Form	kg ai/ha	No		fresh	dry	
China, 1985 Hangzhou	EC	0.015	1	0 1 4 7 10 14 17 20		7.1 5.8 4.6 2.1 0.86 0.21 0.04 0.01	
China, 1985 Hangzhou Last treatment 17-Jul-85	EC	0.03	1	0 1 4 10 14 17 20		8.3 6.4 2.3 1.0 0.44 0.14 0.05	
China, 1985 Hangzhou Last treatment 05-Aug-85	EC	0.03	1	0 4 7 10 14 17 20		15 3.6 1.8 0.81 0.14 0.04 0.02	
China, Xinchang, 2002	EC	0.030	1	7		Green: 0.014, 0.52	11/18/2002 Analytical method not reported
	EC	0.011	1	7		Green: 0.074, 0.32	
	EC	0.011	2	7		Green: 0.00, 0.42	
	EC	0.011	3	7		Green: 0.73, 0.61	
China, Yuhang, 2002	EC	0.030	1	7		Green: 2.1, 2.0	
	EC	0.011	1	7		Green: 1.5, 1.7	
	EC	0.011	2	7		Green: 0.71, 0.82	
	EC	0.011	3	7		Green: 2.0, 1.8	
China, Guangdong, 2006	SC	0.036	2	3 7 10	0.02, 0.01, 0.04 0.02, < 0.01, 0.02 0.05, 0.01, 0.01	0.06, 003, 0.02 0.02, 0.03, 0.01 0.01, 0.01, < 0.01	2008-2-21
China, Guangdong, 2006	SC	0.048	2	3 7 10	0.11, 0.03, 0.08 0.04, 0.03, 0.02 0.05, 0.02, 0.01	0.15, 0.06, 0.12 0.03, 0.11, 0.04 0.03, 0.05, 0.02	
China, Guangdong, 2006	SC	0.036	1	3 7 10	0.04, 0.01, 0.05 0.01, < 0.01, 0.03 0.01, < 0.01, 0.02	0.10, 0.08, 0.13 0.02, 0.03, 0.02 0.01, 0.02, 0.01	
China, Guangdong, 2006	SC	0.048	1	3 7 10	0.01, 0.03, 0.04 0.03, < 0.01, 0.04 0.02, 0.01, 0.02	0.12, 0.10, 0.06 0.05, 0.08, 0.02 0.04, 0.06, 0.01	
China, Zhejiang, 2006	SC	0.036	2	3 7 10	0.14, 0.06, 0.09 0.05, 0.03, 0.04 0.02, 0.01, 0.01	0.04, 0.13, 0.08 0.04, 0.04, 0.02 0.02, 0.02, 0.01	2008-2-21
China, Zhejiang, 2006	SC	0.048	2	3 7 10	0.10, 0.16, 0.07 0.07, 0.02, 0.05 0.02, 0.04, 0.05	0.11, 0.09, 0.15 0.08, 0.06, 0.07 0.01, 0.08, 0.03	
China, Zhejiang, 2006	SC	0.036	1	3 7 10	0.02, 0.06, 0.04 0.02, 0.04, 0.04 0.02, 0.01, 0.01	0.06, 0.11, 0.08 0.05, 0.02, 0.06 0.05, 0.07, 0.03	
China, Zhejiang, 2006	SC	0.048	1	3 7 10	0.09, 0.13, 0.08 0.07, 0.02, 0.06 0.03, 0.03, 0.01	0.17, 0.12, 0.09 0.06, 0.06, 0.09 0.04, 0.02, 0.03	
China, Guangdong, 2007	SC	0.036	2	3 7 10	0.03, 0.02, 0.03 0.01, 0.01, 0.03 0.01, 0.01, 0.01	0.02, 0.07, 0.03 0.01, 0.01, 0.01 0.01, 0.01, < 0.01	2008-2-21
China, Guangdong, 2007	SC	0.048	2	3 7 10	0.08, 0.05, 0.06 0.02, 0.01, 0.03 0.02, 0.01, 0.01	0.12, 0.05, 0.10 0.07, 0.04, 0.03 0.01, 0.02, 0.03	
China, Guangdong, 2007	SC	0.036	1	3 7 10	0.03, 0.06, 0.02 0.02, 0.02, 0.01 0.01, 0.01, 0.01	0.07, 0.14, 0.10 0.01, 0.01, 0.02 0.01, 0.01, 0.01	

Country, year, location	Application			PHI, days	Residues, mg/kg		Report
	Form	kg ai/ha	No		fresh	dry	
China, Guangdong, 2007	SC	0.048	1	3 7 10	0.05, 0.02, 0.03 0.04, 0.02, 0.01 0.01, 0.02, 0.01	0.11, 0.07, 0.16 0.04, 0.02, 0.01 0.02, 0.02, 0.01	
China, Zhejiang, 2007	SC	0.036	2	3 7 10	0.08, 0.15, 0.12 0.02, 0.04, 0.03 0.01, 0.02, 0.01	0.14, 0.09, 0.11 0.02, 0.05, 0.02 0.02, 0.01, 0.01	2008-2-21
China, Zhejiang, 2007	SC	0.048	2	3 7 10	0.18, 0.07, 0.11 0.04, 0.06, 0.03 0.01, 0.02, 0.03	0.12, 0.16, 0.10 0.05, 0.02, 0.08 0.03, 0.02, 0.04	
China, Zhejiang, 2007	SC	0.036	1	3 7 10	0.05, 0.02, 0.06 0.03, 0.05, 0.02 0.01, 0.01, 0.01	0.04, 0.07, 0.05 0.06, 0.03, 0.04 0.02, 0.01, 0.02	
China, Zhejiang, 2007	SC	0.048	1	3 7 10	0.05, 0.11, 0.18 0.05, 0.03, 0.06 0.01, 0.02, 0.02	0.09, 0.16, 0.15 0.08, 0.05, 0.09 0.02, 0.03, 0.01	
India, 1998 Valparai	EC	0.06	1	7	4.8, 5.0, 4.8	5.1, 4.7, 4.9	RESI-2485-98
India, 1998 Nilgiris	EC	0.06	1	7	6.6, 5.0, 6.5	5.5, 5.8, 5.9	
India, 1998 Jorhat	EC	0.06	1	7	0.66, 0.88, 0.89	0.40, 0.42, 0.39	
India, 2005 Valparai	SC	0.02	1	0 7 10 14		37 0.64 0.47 0.33	IR-4 PR No. 10316
		0.04	1	0 7 10 14		67 2.9 1.3 0.68	
India, 2005 Gudalur	SC	0.02	1	0 7 10 14		19 4.8 2.1 0.69	
		0.04	1	0 7 10 14		34 7.6 5.6 1.6	
India 2006	SC	0.08	1	0 3 7 10 14		9.2 3.4 2.1 0.83 0.47	IR-4 PR No. 10316
Indonesia, 1996	EC	0.06 0.10	2	10	0.77, 0.83, 3.9, 1.3	Black: 1.2, 1.5, 2.2, 1.9 Green: 3.9, 2.1, 4.6, 3.7	13.3.9/10 and FCC 0696
Japan, 1985 Uji	WP	0.08	2	 6 13 21		Lab 1 36 18 5.0	Lab 2 31 18 5.6	Tea 01-02
Japan, 1987 Uji	WP	0.08	2	 7 14 21 30		Lab 1 17 5.2 2.3 0.68	Lab 2 16 5.1 2.3 0.78	
Japan, 1987 Ibaragi	WP	0.08	2	 7 14 21 28		Lab 1 5.1 0.98 0.44 0.21	Lab 2 5.6 1.3 0.43 0.26	

FATE OF RESIDUES IN STORAGE AND PROCESSING

In processing

The Meeting received information on the fate of bifenthrin residues during the processing of tomatoes to paste and puree; of maize to meal, flour, oil and wet milling starch; of soya beans to meal and oil; of cotton seed to oil and of hops to beer (Table 90). Information is available on processing of wheat to flour, bred, bran and germ (Tables 91 and 92) and of tea to tea water extract (Table 93). A potato processing study could not be used to derive processing factors, as the RAC contained no residues above LOQ and the processed fraction residues in granule, chips and wet peel were below the LOQ (Report P-2928).

Also information was provided on hydrolysis studies of bifenthrin to assist with identification of the nature of the residues during processing (Lenz, 2007, PC-0364). The hydrolysis of ^{14}C[phenyl ring] bifenthrin was studied at 90, 100, and 120 ºC in sterile buffers at pH 4, 5, and 6, respectively. Radiolabelled test compound was applied to pH 4, 5, and 6 sterile aqueous buffer solutions at an application rate of 0.005 mg/L. The samples were incubated for 20 to 60 minutes at 90, 100, and 120 ºC in the dark. The mean material balance was 100.3, 97.6, and 81.3% of the applied radioactivity for the pH 4, 5, and 6 tests, respectively. Under the sterile hydrolysis conditions of the study, ^{14}C[phenyl ring] bifenthrin was found to be hydrolytically stable at those pH levels.

Processing factors have been calculated for bifenthrin residues in tomato, maize, soya bean, cotton seed, rape seed, wheat, hops and tea (Table 94).

Table 90 Bifenthrin residues in tomato, maize, soya bean, cotton seed, rape seed, hops and processed commodities

Commodity, Country, year, location	Application			PHI, days	Commodity	Bifenthrin residues, mg/kg	Report
	Form	kg ai/ha	No				
Tomato, USA, CA, 2000 Samples from 2 replicates	EC	0.09	4	5	Whole fruit Paste Puree	0.07, 0.08 < 0.05 (0.02), < 0.05 (0.02) < 0.05 (< 0.01), < 0.05 (< 0.01)	P-3498
Maize, USA, IL, 1987	EC	0.11 (4×) 1.1	5	32	Grain Dry milling Coarse meal Grits Meal Flour Hulls Germ Crude oil Refined oil Wet milling Starch Germ Hulls Crude oil Refined oil	0.013 0.0042 < 0.002 0.0071 0.014 0.038 0.0038 0.010 0.012 < 0.002 0.0067 0.020 0.025 0.030	P-2281 P-2300
Soya bean, USA, IO, 2001 Samples from 2 replicates	EC	0.11 (2) 0.55 (1)	3	18	Seed Meal Hulls Refined oil Aspirated grain	< 0.05 (0.02), < 0.05 (0.03) < 0.01, < 0.01 0.06, 0.07 < 0.05 (0.03), 0.05 7.0, 12	P-3531
Cotton seed, USA, TX, 1984 Samples from 2 replicates	EC	1.1	1	6	Seed Linters Hulls Meal Refined oil Soapstock	0.86, 0.95 3.9, 4.0 0.23, 0.38 < 0.05 (< 0.01), < 0.05 (< 0.01) 0.09, 0.08 < 0.05 (0.04), 0.05	RAN-0139
Rape seed, USA, WA,	EC	0.13	2	53	Seed Meal	0.092 < 0.05 (< 0.01)	P-3133

Commodity, Country, year, location	Application			PHI, days	Commodity	Bifenthrin residues, mg/kg	Report
	Form	kg ai/ha	No				
1995					Refined oil	0.15	
Hops, UK, 1989	Sample U 03.8.4.87 spiked at 10 mg/kg				Dried hops Spent hops Yeast Beer	8.7, 9.0 0.29, 0.05 < 0.05 (< 0.01) < 0.05 (< 0.01, < 0.01)	73/82

Three supervised trials on stored wheat grain were conducted in the UK in 1992 (Report No.73/89-1012). Samples taken at the 1-day and 3-month intervals were processed into whole meal flour, whole meal bread, white flour, white bread, and bran. The method for analysis was GC-ECD. The LOQ was 0.01 mg/kg (Table 91).

Two supervised trials on stored wheat grain were conducted in the UK in 1995 (Report No. CRP/95/1363). Storage was at ambient temperature. Samples taken at the 1-, 28-, 56-, and 84-day intervals were processed into whole meal flour; samples taken at the 1 and 56-day intervals were processed into whole meal bread, white flour, white bread, and bran. The method for analysis was GC-ECD. The LOQ) was 0.02 mg/kg (Table 91).

Table 91 Bifenthrin residues in stored wheat grain and processed commodities, UK, 1992 and 1995

Form	Rate g ai/t	No	PHI day	Bifenthrin residues, mg/kg						Report No.
				Wheat RAC	Whole meal flour	Whole meal bread	White flour	White flour Bread	Bran	
UL	0.3	1	1 ~90	0.26 0.25	0.27 0.26	0.22 0.19	0.09 0.08	0.07 0.05	1.2 1.1	1992, AB09 73/89-1012
EC	0.3	1	1 ~90	0.25 0.24	0.28 0.27	0.22 0.20	0.13 0.10	0.07 0.06	1.2 1.2	
EC	0.5	1	1 ~90	0.37 0.38	0.35 0.40	0.36 0.34	0.19 0.18	0.09 0.09	1.9 1.9	
EC	0.3	1	1 28 56 84	0.27, 0.28 0.29, 0.26 0.29, 0.27 0.25, 0.29	0.19, 0.20 0.17, 0.18 0.22, 0.21 0.23, 0.20	0.03, 0.03 0.04, 0.05	0.09, 0.09 0.07, 0.07	0.02, 0.02 0.02, 0.01	0.83, 0.83 0.89, 0.95	1995 13.4.1/14 13.4.1/15 13.4.1/17 CRP/95 /1363
UL	0.3	1	1 28 56 84	0.26, 0.28 0.26, 0.28 0.26, 0.26 0.21, 0.27	0.20, 0.19 0.19, 0.18 0.20, 0.21 0.17, 0.17	0.05, 0.05 0.04, 0.04	0.02, 0.02 0.01, 0.01	0.02, 0.01 0.01, 0.01	0.75, 0.75 0.86, 0.89	

Two supervised trials on stored wheat grain were conducted in Australia in 1998 (Noble, 1999, BI 13.4.1/31). Grain samples were processed into milling products; residues are reported here for grain, bran, whole meal flour, white bread, and whole meal bread. The method for analysis was HPLC-UV. The LOQ was 0.1 mg/kg. Two replicate samples were analysed. In some cases, the results are mean values of double analysis (Table 92).

Table 92 Bifenthrin residues in stored wheat grain and processed commodities, Australia, 1998, EC formulation (Noble, 1999, 13.4.1/31).

Rate g ai/t	PHI days	Bifenthrin residues, mg/kg Wheat RAC	Whole meal flour	Whole meal Bread	Straight run (white) flour	White flour Bread	Bran	Germ
1.0	0	0.87, 0.91	0.32, 0.29	0.75, 0.74	0.26, 0.27	0.22, 0.23	2.6, 2.5	1.4, 1.4
	~90	1.1, 1.0	0.75, 0.79	0.66, 0.76	0.23, 0.21	0.35, 0.30	2.9, 3.0	2.2, 2.2
0.5	0	0.35, 0.33	0.10, 0.25	0.24, 0.24	0.12 (0.14, < 0.1), < 0.1	0.11, < 0.1	0.89, 0.88	0.37, 0.39
	~90	0.31, 0.34	0.27, 0.30	0.27, 0.30	0.12, 0.11	< 0.1, < 0.1	1.1, 1.1	0.85, 0.86

In three trials from Japan, tea leaves (final product) were extracted with hot water (100 °C). The RAC (processed tea, dry) and the water extracts were analysed for bifenthrin residues (Table 93).

Table 93 Bifenthrin residues in tea and tea hot water extract (Report No Tea 01-02).

Country, year	Application Form	kg ai/ha	No	PHI, days	Bifenthrin residues, mg/kg Lab 1 Tea	Lab 1 Extract	Lab 2 Tea	Lab 2 Extract
Japan, 1985	WP	0.08	2	6	36	0.04	31	0.063
				13	18	0.04	18	0.043
				21	5.0	0.01	5.6	0.015
Japan, 1987	WP	0.08	2	7	17	0.030	16	0.034
				14	5.2	0.012	5.1	0.018
				21	2.3	0.006	2.3	0.010
				30	0.68	< 0.005	0.78	0.006
Japan, 1987	WP	0.08	2	7	5.12	0.014	5.6	0.014
				14	0.98	< 0.005	1.3	0.008
				21	0.44	< 0.005	0.43	0.006
				28	0.21	< 0.005	0.26	< 0.005

The transfer factors reflect commercial and household processing as outlined below

Table 94 Summary of processing factors for bifenthrin residues. The factors are calculated from the data recorded in Tables in this section

Raw agricultural commodity (RAC)	Processed commodity	Calculated processing factors	Mean, median or best estimate
Tomato	Paste	< 0.71, < 0.63	< 0.67 (mean)
Tomato	Puree	< 0.71, < 0.63	< 0.67 (mean)
Maize	Coarse meal	0.32	0.32
Maize	Flour	1.1	1.1
Maize	Grits	< 0.15	< 0.15
Maize	Crude oil	0.77, 1.9	1.9 (highest)
Maize	Refined oil	0.92, 2.3	2.3 (highest)
Maize	Germ	0.29, 0.52	0.52 (highest)
Maize	Hulls	2.9, 1.5	2.9 (highest)
Maize	Starch	< 0.15	< 0.15
Soya bean	Meal	< 0.2, < 0.2	< 0.2
Soya bean	Hulls	1.2, 1.4	1.3
Soya bean	Refined oil	< 1, 1	1
Soya bean	Aspirated grain	140, 240	190 (mean)
Wheat	Bran	2.5, 2.6, 2.7, 2.7, 2.7, 2.9, 3.0, 3.0, 3.0, 3.1, 3.1, 3.2, 3.3, 3.3, 3.5, 3.5, 4.4, 4.6, 4.6, 5.0, 5.0, 5.1	3.15 (median, n=22)
Wheat	Whole meal flour	0.29, 0.32, 0.37, 0.59, 0.63, 0.64, 0.68, 0.68, 0.69, 0.69, 0.70, 0.71, 0.73, 0.76, 0.76, 0.77, 0.77, 0.78, 0.79, 0.81, 0.81, 0.87, 0.88, 0.92, 0.95, 1.0, 1.0, 1.1, 1.1, 1.1	0.765 (median, n=30)
Wheat	Whole meal bread	0.11, 0.11, 0.14, 0.15, 0.15, 0.18, 0.19, 0.19, 0.60, 0.69, 0.73, 0.76, 0.76, 0.81, 0.83, 0.85, 0.86, 0.87, 0.88, 0.88, 0.89, 0.97	0.75 (median, n=22))
Wheat	White flour	0.038, 0.038, 0.071, 0.077, 0.21, 0.21, 0.24, 0.26,	0.31 (median, n=22)

Raw agricultural commodity (RAC)	Processed commodity	Calculated processing factors	Mean, median or best estimate
		< 0.3, 0.3, 0.3, 0.32, 0.32, 0.32, 0.33, 0.34, 0.35, 0.39, 0.42, 0.47, 0.51, 0.52	
Wheat	White flour bread	0.036, 0.037, 0.038, 0.038, 0.069, 0.071, 0.074, 0.077, 0.20, 0.24, 0.24, 0.25, 0.25, 0.25, 0.27, 0.28, < 0.29, < 0.30, 0.30, 0.31, < 0.32, 0.32	0.245 (median, n=22)
Wheat	Germ	1.1, 1.2, 1.5, 1.6, 2.0, 2.2, 2.5, 2.7	1.8 (median, n=8)
Cotton seed	Linters	4.5, 4.2	4.4 (mean)
Cotton seed	Hulls	0.27, 0.40	0.34 (mean)
Cotton seed	Meal	< 0.058, < 0.053	< 0.06 (highest)
Cotton seed	Refined oil	0.10, 0.084	0.1 (highest)
Rape seed	Meal	0.54	0.54
Rape seed	Refined oil	1.6	1.6
Hops	Beer	< 0.0055, < 0.0057	< 0.006
Tea	Water extract	0.001, 0.0018, 0.002, 0.002, 0.0021, 0.0023, 0.0023, 0.0025, 0.0026, 0.0027, 0.0027, 0.003, 0.0035, 0.0043, < 0.005, 0.0062, < 0.007, 0.0077, < 0.011, 0.014, < 0.019, < 0.024	0.003 (median, n=22)

RESIDUES IN ANIMAL COMMODITIES

Farm animal feeding studies

The Meeting received three lactating cow feeding studies and a laying hen feeding study, which provided information on likely residues resulting in animal commodities, milk and eggs from bifenthrin residues in the animal diet.

Lactating dairy cows

In the first in-life study, four groups of Holstein dairy cows (three per group) were dosed with unlabeled bifenthrin (Fletcher, 1984, PC-0023). The dose levels based on a nominal diet were 50 ppm, 15 ppm, 5 ppm, and 0.5 ppm bifenthrin per day. The chemical was administered on part of the grain ration in capsules, twice daily, at the morning and afternoon milking, for 28 consecutive days. A control group was also fed capsules containing grain, but without the chemical. Milk samples were taken twice daily on test days -1, 0, 1, 3, 5, 8, 12, 16, 20, 24, 28, and 31. At day 28, ten cows were sacrificed and the five remaining cows were sacrificed on day 31. The findings of these reports are summarised in Table 95.

The analytical reports by Akkari (1984, P-1030 and 1985, P-1030) provide results for analysis of bifenthrin from the Fletcher 1984 study. The LOQs were established at 0.02 mg/kg and 0.10 mg/kg for milk and tissues, respectively. LODs were set at 0.005 mg/kg for milk and 0.01 mg/kg for tissues.

Table 95 Residues of bifenthrin in whole milk and tissues from cow feeding test (Fletcher, 1984, PC-0023; Akkari, 1984, P-1030)

Matrix	Bifenthrin residues, mg/kg					
	Feeding level 5 ppm		Feeding level 15 ppm		Feeding level 50 ppm	
	treated	control	treated	control	treated	control
Milk						
Study Day						
0	ND [a]	ND	< 0.02 (ND–0.01)	ND	0.02, 0.02, 0.03	0.02
1	0.03, 0.04, 0.09	ND			0.12, 0.030, 0.34	0.02
3	0.05, 0.05, 0.13	(0.01)[b]	0.08, 0.11, 0.15	(0.01)	0.48, 0.59, 0.68	0.02
5	0.06, 0.08, 0.16	ND			0.47, 0.49, 0.63	0.03
8			0.16, 0.22, 0.14	ND	0.62, 0.75, 0.80	0.03
12	0.04, 0.04, 0.10	0.02			0.55, 0.83, 1.00	0.02
16			0.11, 0.15, 0.16	0.02	0.43, 0.66, 0.68	(0.01)
20	0.07, 0.07, 0.14	0.02			0.44, 0.70, 0.75	0.02
24			0.14, 0.16, 0.24	ND	0.54, 0.73, 0.74	0.03
28	0.05, 0.07, 0.12	ND			0.53, 0.63, 0.80	0.04
Muscle						
Adductor	< 0.1 (0.03, 0.04)	(0.02)	< 0.1 (0.08, 0.09)	(0.02)	0.11, 0.23	ND
Pectoral	< 0.1 (0.05, 0.06)	(0.01)	0.15, 0.24	(0.02)	0.33, 0.88	(0.02)
Cardial	< 0.1 (0.04, 0.06)	(0.01)	0.11, 0.17	(0.029)	0.27, 0.41	ND
Liver	< 0.1 (ND, 0.02)	ND	< 0.1 (0.02, 0.03)	ND	< 0.1 (0.07, 0.09)	ND
Kidney	< 0.1 (0.04), 0.10	(0.02)	0.18, 0.19	ND	0.44, 0.49	(0.02)
Fat						
Subcutaneous	0.25, 0.74	(0.03)	0.68, 0.92	(0.02)	2.0, 2.7	(0.04)
Peritoneal	0.77, 1.7	ND	1.5, 2.2	(0.05)	3.3, 5.8	(0.03)

[a] ND = Not detected (below LOD, < 0.01 mg/kg)

[b] Numbers in parentheses are estimated values between the limit of detection and method sensitivity

In the second in-life study (Fletcher, 1987, PC-0070), two groups of Holstein dairy cows (three per group) were dosed with unlabeled bifenthrin at the concentration levels of 5 ppm and 50 ppm bifenthrin per day. The chemical was administered on part of the grain ration in capsules, twice daily, at the morning and afternoon milking, for 28 consecutive days. A control group was also fed capsules containing grain, but without the chemical. Milk samples were taken twice daily on test days 0, 1, 3, 5, 8, 12, 16, 20, 24, 28, and 31. At day 28, six cows were sacrificed and the three remaining cows were sacrificed on day 31. The analytical reports by Witkonton (1987, P-1703 and P-1704) provide results for analysis of bifenthrin and metabolites. For bifenthrin in milk fat the LOQ was 0.2 mg/kg and the LOD 0.05 mg/kg. For the metabolites, the LOQs were set at 0.02 mg/kg for milk and 0.05 mg/kg for tissues, respectively (LODs 0.005 for milk, 0.01 for tissues). Results are summarised in Tables 96 and 97.

Table 96 Residues of bifenthrin in milk fat, values in mg/kg (Fletcher, 1987, PC-0070; Witkonton, 1987, P-1703)

Study day	Bifenthrin			
	Feeding at 5 ppm		Feeding at 50 ppm	
	values of 3 animals	mean	values of 3 animals	mean
0	< 0.2	< 0.2	< 0.2	< 0.2
3	0.72, 0.78, 0.97	0.82	7.8, 8.8, 9.6	8.7
8	0.64, 0.67, 1.6	0.97	7.8, 8.9, 10.2	9.0
16	0.54, 0.62, 1.2	0.79	8.0, 8.2, 10.1	8.8
24	0.35, 0.70, 1.1	0.71	7.4, 8.6, 9.4	8.5
28	0.48, 0.50, 0.61	0.53	8.0, 9.4, 10	9.3

Table 97 Residues of biphenyl alcohol in milk; biphenyl alcohol and biphenyl acid in cow tissues, values in mg/kg (Fletcher, 1987, PC-0070; Witkonton, 1987, P-1704)

Matrix	BP-alcohol		BP-acid	
	Feeding at 5 ppm	Feeding level 50 ppm	Feeding at 5 ppm	Feeding at 50 ppm
Milk		whole milk		
Study day				
0	-[a]	< 0.02	-	-
3	-	< 0.02	-	-
8	-	< 0.02	-	-
16	-	< 0.02	-	-
24	-	< 0.02	-	-
28	-	< 0.02	-	-
Muscle				
Adductor	-	< 0.05	-	< 0.05
Pectoral	< 0.05	< 0.05 (0.02), 0.07	-	< 0.05
Cardial	< 0.05	0.05, 0.07	-	< 0.05
Liver	< 0.05	< 0.05 (0.03, 0.04)	< 0.05	< 0.05 (0.04), 0.05
Kidney	< 0.05	< 0.05 (0.03), 0.11	< 0.05	< 0.05 (0.04), 0.14
Fat				
Subcutaneous	< 0.05 (0.03)[b]	0.18, 0.36	-	< 0.05
Peritoneal	0.06, 0.11	0.69, 1.1	-	< 0.05

[a] Blank = not analysed

[b] Numbers in parentheses are estimated values between the LOQ and LOD

The in-life phase of the third cow feeding study was conducted in 1986 (Nagel and Culligan, 1991, P-1367). Three groups of cows were used for this study, with three lactating Holstein dairy cows. One group was used as a control group and was not dosed with bifenthrin. The two remaining groups of cows were dosed daily at 5 ppm and 50 ppm bifenthrin respectively. The chemical was orally administered in equally divided doses via gelatine capsules at the morning (AM) and afternoon (PM) milkings for a period of 28 consecutive days. Tissue samples of peritoneal fat and subcutaneous fat were analysed for 4'-hydroxy-bifenthrin. The LOQ was set at 0.05 mg/kg and the LOD was set at 0.01 mg/kg.

No detectable (< 0.01 mg/kg) 4'-hydroxy-bifenthrin residue was found in any of the cow fat samples analysed. In addition, no 4'-hydroxy-bifenthrin residue or interfering peaks were found in any of the control samples at the limit of detection.

Laying hens

An in-life poultry feeding study was conducted (Fletcher, 1987, PC-0091) to assess the fate of bifenthrin residue when ingested by hens. Three groups of white leghorn hens (24 per group) were dosed via gelatine capsules with unlabeled bifenthrin. The dose levels were 0.0025 ppm, 0.025 ppm and 0.25 ppm bifenthrin in the diet per day. A control group with 24 birds was also daily fed gelatine capsules containing only 0.048 mL n-hexane, but without the chemical. The hens were dosed with one capsule each for 28 consecutive days. Eggs were collected daily from all birds throughout the investigation and also during the last week of the quarantine period. The eggs laid in the test and control groups on test day -1, 0, 1, 3, 5, 8, 11, 14, 18, 22, 26, 28, 31, and 35 were retained. White and yolk were separated and pooled on a group basis and then quick-frozen. To determine the degree of residue depletion after three and seven days without receiving bifenthrin at day 28 eight birds were sacrificed, at day 31 another eight, and at day 35 the last eight birds of each group were sacrificed. Pooled samples of muscle (thigh, cardiac, breast), liver, kidneys, gizzard, fat (subcutaneous), and skin from eight birds of each test level were collected.

Tissue samples of the white leghorn hens were analysed for bifenthrin residues and total biphenyl alcohol residues. Tissue samples analysed were muscle (thigh, breast), fat (subcutaneous), liver, and gizzard (Barrett, 1987, P-1883; Witkonton, 1987, P-1843). LOQ was validated for both bifenthrin and total biphenyl alcohol at 0.02 mg/kg in muscles and 0.05 mg/kg in fat, liver, and gizzard. LODs were set for both bifenthrin and total biphenyl alcohol at 0.005 mg/kg in muscles and

0.01 mg/kg in fat liver and gizzard respectively. Liver of the highest dose group was analysed for TFP acid (LOQ 0.05 mg/kg, LOD 0.01 mg/kg). Results are summarised in Table 98.

No bifenthrin residues were found in any of the tissue samples of the 0.25 ppm dosing group. Total biphenyl alcohol could only be detected in subcutaneous fat of the 0.25 ppm dosing group, but was always below LOQ. It was not detected at the lower dosing level of 0.025 ppm. No TFP acid residues were found in any of the liver samples of the 0.25 ppm dosing group. If no residues were found in tissue samples of the highest dosing group analyses of the lower dosing groups were omitted.

Table 98 Residues of bifenthrin, total biphenyl alcohol and TFP acid in hen tissues (Fletcher, 1987, PC-0091; Witkonton 1987, P-1843; Barrett 1987, P-1883)

Matrix [a]	Residues in hen tissues, mg/kg			
	Bifenthrin [d]	Biphenyl alcohol [d]		TFP acid [e]
	Feeding level 0.25 ppm	Feeding level 0.25 ppm	Feeding level 0.025 ppm	Feeding level 0.25 ppm
Muscle				
Thigh	< 0.02	< 0.02	-[c]	-
Breast	< 0.02	< 0.02	-	-
Subcutaneous fat	< 0.05	< 0.05 (0.01)[b]	< 0.05	-
Liver	< 0.05	< 0.05	-	< 0.05
Gizzard	< 0.05	< 0.05	-	-

[a] All control samples showed no detectable residues

[b] Numbers in parentheses are estimated values between the limit of detection and method sensitivity

[c] Blank = Not analysed

[d] Witkonton 1987, P-1843

[e] Barrett 1987, P-1883

Egg samples of the above mentioned feeding study in white leghorn chickens (Fletcher, 1987, PC-0091) were analysed for hydroxymethyl bifenthrin and biphenyl alcohol related residues. Residues of hydroxymethyl bifenthrin (found as fat soluble conjugates) were released by saponification to biphenyl alcohol residues, which were then determined (Leppert, 1987, RAN-0204; Gohre, 1987, RAN-0203). LOQ and LOD were set at 0.01 mg/kg and 0.0025 mg/kg, respectively. Egg samples were also analysed for bifenthrin residues.

The results are summarised in Table 99. None of the samples at any dose level showed detectable hydroxymethyl bifenthrin residues. Only selected samples of the mid and low dose levels were analysed based on the maximum bifenthrin residues found in the high dose level samples in the study of Leppert (1987, RAN-0204). Bifenthrin was only found in the 5, 11, 14, and 18 day egg samples from the 0.25 ppm dose level. These values were only estimated because of the fact that all of them were always below the LOQ.

Table 99 Residues of 4'-Hydroxymethyl bifenthrin and bifenthrin in egg samples (Leppert, 1987, RAN-0204)

Sampling day	Residues [a] in eggs (mg/kg)					
	4'-Hydroxymethyl Bifenthrin [b]			Bifenthrin [c]		
	Feeding at 0.0025 ppm	Feeding at 0.025 ppm	Feeding at 0.25 ppm	Feeding at 0.0025 ppm	Feeding at 0.025 ppm	Feeding at 0.25 ppm
-1	-[d]	-	< 0.01	< 0.01	< 0.01	< 0.01
0	-	-	< 0.01	< 0.01	< 0.01	< 0.01
1	-	-	< 0.01	< 0.01	< 0.01	< 0.01
3	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
5	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01 (0.003–0.004)[e]
8	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
11	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01 (0.003)
14	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01 (0.002–0.004)
18	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01 (0.002)
22	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
26	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

Sampling day	Residues [a] in eggs (mg/kg)					
	4'-Hydroxymethyl Bifenthrin [b]			Bifenthrin [c]		
	Feeding at 0.0025 ppm	Feeding at 0.025 ppm	Feeding at 0.25 ppm	Feeding at 0.0025 ppm	Feeding at 0.025 ppm	Feeding at 0.25 ppm
28	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
31	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
35	-	-	< 0.01	< 0.01	< 0.01	< 0.01

[a] All control samples showed no detectable residues

[b] Gohre 1987, RAN-0203

[c] Leppert 1987, RAN-0204

[d] Blank = Not analysed

[e] Numbers in parentheses are estimated values between LOD and LOQ

RESIDUES IN FOOD IN COMMERCE OR AT CONSUMPTION

Australia Monitoring

Bifenthrin was included in the list of analytes examined in foods in the 20th Australian Total Diet Survey (FSANZ, 2003). The results are shown in Table 100.

Table 100 Results of bifenthrin analysis of foods in the 20th Australian Total Diet Survey (FSANZ, 2003)

Food	No. of samples	No. of 'ND' samples	Mean (mg/kg)	Median (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)
Sweet peppers	21	20	0.001	ND [a]	ND	0.018
Nectarines	21	18	0.004	ND	ND	0.04
Tomatoes	28	27	0.001	ND	ND	0.04

[a] ND = less than LOD, i.e. 0.01 mg/kg

In Australia, bifenthrin was included in the National Residue Survey Program of monitoring agricultural commodities in 2004–2005 (NRS, 2005), 2005–2006 (NRS, 2006), 2006–2007 (NRS, 2007) and 2007–2008 (NRS, 2008). The results are shown in Tables 101 to 104.

Table 101 Results of bifenthrin analysis in the National Residue Survey Program of monitoring agricultural commodities in Australia in 2004–2005 (NRS, 2005)

Commodity	Limit of reporting, mg/kg	Australian MRL, mg/kg	No of analyses	No of residues
Buffalo fat	0.02	2	10	0
Camel fat	0.02	2	10	0
Cattle fat	0.02	2	1096	0
Deer fat	0.02	2	26	0
Game pig fat	0.02	2	75	0
Goat fat	0.02	2	99	0
Horse fat	0.02	2	19	0
Pig fat	0.02	2	299	0
Ratite (Ostrich & Emu) fat	0.02	not set	28	0
Sheep fat	0.02	0.05	725	1 (< MRL)
Barley grain	0.01	2	1237	0
Canola (Rape seed), grain	0.01	0.02	234	0
Chickpea, grain	0.01	0.02	11	0
Field pea, grain	0.01	0.01	52	0
Lupin, grain	0.01	0.02	103	0
Oats grain	0.01	2	73	0
Sorghum grain	0.01	2	253	1(< MRL)
Wheat grain	0.01	2	2823	0
Wheat bran	0.01	2	94	0
Wheat flour	0.01	2	94	0
Apple	0.02	1	221	0

Commodity	Limit of reporting, mg/kg	Australian MRL, mg/kg	No of analyses	No of residues
Pear	0.1	1	71	0

Table 102 Results of bifenthrin analysis in the National Residue Survey Program of monitoring agricultural commodities in Australia in 2005–2006 (NRS, 2006)

Commodity	Limit of reporting, mg/kg	Australian MRL, mg/kg	No of analyses	No of residues
Buffalo fat	0.02	2	10	0
Cattle fat	0.02	2	1110	0
Deer fat	0.02	2	25	0
Game pig fat	0.02	2	75	0
Goat fat	0.02	2	99	0
Horse fat	0.02	2	19	0
Kangaroo fat	0.02	2	75	0
Pig fat	0.02	2	291	0
Ratite (Ostrich) fat	0.02	not set	22	0
Sheep fat	0.02	2	714	0
Barley grain	0.01	2	905	0
Canola (Rape seed), grain	0.01	0.02	190	0
Chickpea, grain	0.01	0.02	8	0
Field pea, grain	0.01	0.01	40	0
Lupin, grain	0.01	0.02	89	0
Oats grain	0.01	2	68	0
Sorghum grain	0.01	2	136	1(< MRL)
Wheat grain	0.01	2	2537	0
Wheat bran	0.01	2	141	0
Wheat flour	0.01	2	139	0
Apple	0.02	0.05	250	1 (< MRL)
Pear	0.02	0.5	68	0

Table 103 Results of bifenthrin analysis in the National Residue Survey Program of monitoring agricultural commodities in Australia in 2006–2007 (NRS, 2007)

Commodity	Limit of reporting, mg/kg	Australian MRL, mg/kg	No of analyses	No of residues
Camel fat	0.02	2	10	0
Cattle fat	0.02	2	1117	0
Deer fat	0.02	2	25	0
Goat fat	0.02	2	100	0
Horse fat	0.02	2	20	0
Kangaroo fat	0.02	2	76	0
Pig fat	0.02	2	299	0
Ratite (Ostrich) fat	0.02	not set	22	0
Sheep fat	0.02	2	787	1 (< MRL)
Wild boar fat	0.02	2	75	0
Barley grain	0.01	2	569	0
Canola (Rape seed), grain	0.01	0.02	185	0
Chickpea, grain	0.01	0.02	8	0
Faba (Fava) bean, grain	0.01	0.02	8	0
Field pea, grain	0.01	0.01	41	0
Lupin, grain	0.01	0.02	38	0
Oats grain	0.01	2	38	0
Sorghum grain	0.01	2	63	0
Triticale grain	0.01	2	1	0
Wheat grain	0.01	2	2054	0
Wheat (durum) grain	0.01	2	5	0
Wheat bran	0.01	2	162	0
Wheat flour	0.01	2	156	0
Wheat semolina	0.01	2	6	0
Apple	0.02	0.05	455	7 (4> MRL)

Commodity	Limit of reporting, mg/kg	Australian MRL, mg/kg	No of analyses	No of residues
Pear	0.02	0.5	91	15 (< MRL)

Table 104 Results of bifenthrin analysis in the National Residue Survey Program of monitoring agricultural commodities in Australia in 2007 – 2008 (NRS, 2008)

Commodity	Limit of reporting, mg/kg	Australian MRL, mg/kg	No of analyses	No of residues
Camel fat	0.02	2	10	0
Cattle fat	0.02	2	1119	4 (< MRL)
Deer fat	0.02	2	15	0
Goat fat	0.02	2	101	0
Horse fat	0.02	2	20	0
Kangaroo fat	0.02	2	31	0
Pig fat	0.02	2	309	0
Ratite (Emu) fat	0.02	not set	4	0
Ratite (Ostrich) fat	0.02	not set	12	0
Sheep fat	0.02	2	801	2 (< MRL)
Wild boar fat	0.02	2	31	0
Barley grain	0.01	2	728	0
Canola (Rape seed), grain	0.01	0.02	340	0
Chickpea, grain	0.01	0.02	22	0
Faba (Fava) bean, grain	0.01	0.02	9	0
Field pea, grain	0.01	0.01	25	0
Lentil, grain	0.01	0.02	11	0
Lupin, grain	0.01	0.02	12	0
Maize grain	0.01	2	5	0
Mung bean, grain	0.01	0.02	1	0
Oats grain	0.01	2	35	0
Sorghum grain	0.01	2	152	0
Soybean (Soya bean), grain	0.01	0.02	3	0
Sunflower, grain	0.01	not set	2	0
Triticale grain	0.01	2	1	0
Wheat grain	0.01	2	1688	0
Wheat (durum) grain	0.01	2	8	0
Wheat bran	0.01	2	193	0
Wheat (durum) bran	0.01	2	5	0
Wheat flour	0.01	2	190	0
Wheat semolina	0.01	2	8	0
Apple	0.02	0.05	469	2 (> MRL)
Pear	0.02	0.5	141	0

USA Monitoring

Bifenthrin was included in the Pesticide Data Program conducted by the United States Department of Agriculture (USDA). The results from 2003 to 2007 are shown in Table 105. The data reported below for 2003 to 2007 can be found at: http://www.ams.usda.gov/science/pdp/download.htm#reports.

Table 105 Bifenthrin residues of the USDA Pesticide Data Program of monitoring pesticides in foods, 2003–2007

Commodity	No of samples	Samples with detections	% of samples with detections	Range of values detected, mg/kg	CODEX MRL, mg/kg
2003					
Asparagus	250	0			-
Asparagus, canned	253	0			-
Cantaloupe	186	0			-
Cucumbers	739	5	0.7	0.018[a]	-
Green beans, canned	743	114	15.3	0.013–0.047	-
Mushrooms	394	0			-
Pears	187	0			0.5

Commodity	No of samples	Samples with detections	% of samples with detections	Range of values detected, mg/kg	CODEX MRL, mg/kg
Spinach	674	0			-
Sweet bell peppers	741	79	10.7	0.005–0.089	-
Sweet corn, frozen	547	0			-
Sweet peas, frozen	549	0			-
Sweet potatoes	734	2	0.3	0.027[a]	-
Butter	732	63	8.6	0.003[a]	0.05 (milk)
2004					
Apples	546	0			
Cantaloupe	742	0			
Cauliflower	185	0			
Cucumbers	557	2	0.4	0.017[a]	
Grapes	738	0			
Green beans, canned	185	9	4.9	0.013–0.017	
Green beans	548	20	3.6	0.012–0.12	
Lettuce	743	0			
Orange juice	186	0			0.05
Oranges	742	0			0.05
Pears	741	0			0.5
Spinach, canned	371	0			
Sweet bell peppers	558	74	13.3	0.005–0.096	
Sweet potatoes	743	1	0.1	0.017[a]	
Strawberries	731	50	6.8	0.017–0.30	
Winter squash	364	8	2.2	0.017[a]	
Milk	739	3	0.4	0.0001	0.05
2005					
Apples	743	0			-
Cantaloupe	558	0			-
Cauliflower	741	0			-
Eggplant	736	1	0.1	0.047[a]	-
Grapefruit	742	0			0.05
Grapes	739	1	0.1	0.018[a]	-
Green beans	181	5	2.8	0.012–0.39	-
Green beans, frozen	555	70	12.6	0.012–0.093	-
Lettuce	743	0			-
Orange juice	744	0			0.05
Oranges	741	0			0.05
Pears	555	0			0.5
Plums	573	0			-
Plums, dried	153	0			-
Strawberries	737	72	9.8	0.017–0.44	1
Watermelon	182	3	1.6	0.007–0.018	-
Winter squash	731	12	1.6	0.017–0.027	-
Milk	746	17	2.3	0.0001–0.00067	0.05
Heavy cream	369	1	0.3	0.001[a]	0.05 (milk)
Pork, fat	352	0			
Pork, muscle	352	0			
2006					
Applesauce	744	0			-
Bananas	742	0			-
Broccoli	185	2	1.1	0.005[a]	-
Carrots	743	0			-
Cauliflower	558	0			-
Cranberries	316	0			-
Eggplant	740	1	0.1	0.047[a]	-
Grapefruit	743	0			0.05
Greens, collard	17	0			-
Greens, kale	37	0			-
Orange, juice	557	0			0.05
Peaches	90	0			-
Plums	515	0			-
Plums, dried	224	0			-
Potatoes, frozen	744	0			0.05

Commodity	No of samples	Samples with detections	% of samples with detections	Range of values detected, mg/kg	CODEX MRL, mg/kg
Raisins	372	0			-
Spinach	511	9	1.8	0.005[a]	-
Summer squash	186	18	9.7	0.007–0.043	-
Sweet peas, frozen	744	0			-
Watermelon	550	3	0.5	0.007–0.017	-
Winter squash	369	0			-
Poultry, breast	655	0			0.05 (meat)
Poultry, thigh	655	0			0.05 (meat)
Peanut butter	739	0			
2007					
Apple juice	368	0			-
Bananas	744	0			-
Blueberries	711	21	3	0.005–0.011	-
Blueberries, frozen	22	0			-
Broccoli	736	8	1.1	0.005–0.027	-
Carrots	744	0			-
Celery	739	0			-
Cherries	419	189	45.1	0.0006–0.007	
Green beans	739	33	4.5	0.017–0.18	
Greens, collard	117	0			-
Greens, kale	96	0			-
Nectarines	563	0			-
Peaches	555	2	0.4	0.034–0.038	-
Potatoes, frozen	800	0			
Raisins	371	0			-
Summer squash	742	33	4.4	0.007–0.052	-
Tomatoes	741	17	2.3	0.038–0.11	-
Corn, grain	640	0			

[a] Only one distinct detected concentration

UK Monitoring

Bifenthrin has also been included in monitoring programs in the UK. Some of the more contemporary monitoring reports are described below. Information can be found at www.pesticides.gov.uk/prc.

From the 2007 grapes survey, in samples taken from September 2007 to December 2007, three samples contained detectable residues of bifenthrin ranging from 0.03 to 0.04 mg/kg (EU MRL 0.2). In samples taken November and December 2008 during the 2008 grapes survey, one sample showed detectable residues of bifenthrin at 0.02 mg/kg.

The Pesticides Residues Committee, "Pesticides Residues Monitoring Report for the Third Quarter 2008" reports bifenthrin residues detected in retail samples purchased between May and September 2008 as follows:

44 samples apricots:	2 samples 0.01–0.04 mg/kg	2 samples < 0.01 mg/kg
7 samples blackberries:	3 samples 0.03–0.04 mg/kg	4 samples < 0.01 mg/kg
23 samples grapes:	1 sample 0.02 mg/kg	23 samples < 0.01 mg/kg

Bifenthrin was not found on any retail samples of onions purchased between May and August 2008, or any rice purchased between July and September 2008.

The Pesticides Residues Committee, Pesticides Residues Monitoring Report "School Fruit and Vegetable Scheme Summer Term 2008" also reports on bifenthrin residues found on these commodities as follows: Bifenthrin was not detected in Apples, Bananas, Cucumbers, Citrus, Strawberries, or Sugar snap peas sampled from April to July 2008 (LOD 0.01 mg/kg).

European Union Monitoring

Monitoring of residues by the EU Commission in 2005 can be found at http://ec.europa.eu/food/fvo/special reports/pesticide_residues.en.htm. For bifenthrin, results from the EU co-ordinated monitoring program in 2005 showed 0.36% (36), of the 10065 samples (pears, beans, potatoes, carrots, oranges, mandarins, spinach, rice and cucumbers) assayed, showed residues below, or at, the MRL, while no sample had residues above the MRL. The most frequent detections (2.04%) for bifenthrin were in bean samples. 10029 samples had non-detectable residues.

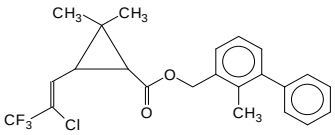
Monitoring of pesticide residues by the EU Commission in 2006 can also be found at http://ec.europa.eu/food/fvo/specialreports/pesticide_residues/report_2006_en.pdf. For bifenthrin, results from the EU co-ordinated monitoring program in 2006 showed 1.55% (136), of the 8793 samples assayed, showed residues below, or at, the MRL, while 0.02% of the samples had residues above the MRL. 8655 samples (aubergines, bananas, cauliflower, grapes, orange juice, peas, peppers and wheat) had no detectable residues in 2006. The most frequent MRL exceedances (0.12% of samples assayed) for bifenthrin were in cauliflower (maximum residue found 0.65 mg/kg). The crop commodity where there were the most detects (3.63%) was grapes. No indicative exposure assessment for acute risk for which an ARfD was set was conducted for bifenthrin.

NATIONAL RESIDUE DEFINITIONS

The national residue definitions for plant and animal commodities are reported by Australia, Brazil, China, European Union, Japan, Korea, Taiwan and the USA as “bifenthrin” (status February 2010).

APPRAISAL

Bifenthrin is a pyrethroid insecticide and miticide. It was first evaluated by the 1992 JMPR (T, R) and subsequently for residues a number of times. The pesticide was evaluated for toxicology by the 2009 JMPR within the periodic review programme of the CCPR. The periodic review for residues was scheduled at the Forty-first Session of the CCPR for the 2010 JMPR.



Bifenthrin is a mixture of the E- and the Z-isomer with a Z/E-ratio of 99.67% Z-bifenthrin: 0.33% E-bifenthrin and can be present as a cis-isomer and a trans-isomer. The ratio of cis- to trans-isomers is typically 98.65: 1.35 (specification = 97% cis minimum: 3% trans maximum).

List of metabolites

4’Hydroxy-bifenthrin	3-(4’hydroxyphenyl)-2-methylphenyl-methyl-cis,trans-3-(2-chloro-3,3,3-trifluoro-1-propenyl)-2,2-dimethyl-cyclopropane-carboxylate
Hydroxy-methyl-bifenthrin	2-methyl-[1,1’biphenyl]-3-yl)-methyl-cis-3-(2-chloro- 3,3,3-trifluoro-1-propenyl) trans-2-hydroxy-methyl-2-methyl-cyclopropane-carboxylate
TFP acid	cis-trans-3-(2-chloro-3,3,3-trifluoro-1-propenyl)-2,2-dimethyl-cyclopropane- carboxylic acid
Acetyl-cyclopropane-carboxylic acid	cis-trans-3-acetyl-2,2-dimethyl-cyclopropane-carboxylic acid
Biphenyl alcohol (BP alcohol)	2-methyl-3-phenylbenzyl alcohol
Biphenyl acid (BP acid)	2-methyl-3-phenylbenzoic acid

Animal metabolism

The Meeting received studies on lactating goats and laying hens dosed with either acid cyclopropyl-[^{14}C]-bifenthrin (CP label) or phenyl-^{14}C-bifenthrin (PH label). Studies on rats were reviewed by JMPR during toxicological evaluation in 2009.

Four lactating goats were orally dosed with [^{14}C]-bifenthrin daily for 7 consecutive days at a body weight level of 2.3 mg/kg/day - equivalent to a dietary level of 79 ppm. TRR in milk, liver, fat, kidneys and heart ranged from 0.7–1.5, 1.6-3.9, 1.8–2.8, 0.3–1.0 and 0.4–0.6 mg/kg [^{14}C]-bifenthrin equivalents, respectively. TRR in muscle were relatively lower and amounted to a range of 0.2–0.4 mg/kg. Analysis of ^{14}C in excreta showed that 40–52% and 7.7–17% of the total administered dose was recovered in faeces and urine, respectively.

Bifenthrin was the major product in milk (72–82% of TRR, 0.7–1.1 mg/kg), fat (78–80% of TRR, 1.6–1.8 mg/kg) and muscle (74–88% of TRR, 0.2–0.3 mg/kg). Parent chemical was also found to be a significant residue in kidney and liver tissue, amount to 16–22% of TRR (0.082–0.12 mg/kg) and 19–44% (0.7–0.9 mg/kg), respectively. Biphenyl acid was a significant product identified in kidney and liver tissue (35% of TRR, 0.14 mg/kg and 29% of TRR, 0.5 mg/kg, respectively). Biphenyl alcohol was detected at lower levels relative to parent chemical in milk (13% of TRR) and fat (10% of TRR). TFP acid was detected as a significant metabolite in milk (8.8% of TRR), liver (4% of TRR) and kidney (14% of TRR). Other metabolites including 4'-hydroxy-bifenthrin, hydroxyl-methyl-TFP acid and biphenyl aldehyde were detected in minor amounts (< 5% of TRR).

Laying hens were dosed by [^{14}C]-bifenthrin for ten days at a body weight level of 1.55 mg/kg/day - equivalent to a dietary level of 31 ppm. The results (values as bifenthrin equivalents) indicated:

- orally administered ^{14}C-bifenthrin is eliminated primarily *via* the excreta (> 90% of the applied radioactivity);
- measurable levels of residues are transferred to tissues of the body, concentrating mostly in the fat (2.1–2.2 mg/kg) and liver (1.4–1.9 mg/kg), the activity in all tissues accounted for less than 0.4% of the applied dose;
- residues in the egg yolk were < 0.8% (max. 3.3 mg/kg) and in egg white < 0.03% (max. 0.05 mg/kg) of the applied radioactivity.

Metabolism of bifenthrin in hens occurred primarily on the cyclopropyl (acid) moiety of the molecule. Hydroxylation on the gem-dimethyl system was followed by formation of organosoluble conjugates with either palmitic or oleic acid. Bifenthrin and these fatty acid conjugates were the major compounds observed in all tissues studied. In egg yolk from the 10 days interval, approximately 40% of TRR (1.4 mg/kg bifenthrin equivalents) was present as bifenthrin. An additional 35% (1.1–1.3 mg/kg) was represented by a mixture of fatty acid conjugates. Unconjugated hydroxyl-methyl-bifenthrin made up another 3.5–4.6% (0.12–0.15 mg/kg) of the residue. Fragmentation products of bifenthrin (or conjugates) were observed as biphenyl alcohol to the extent of 4.2% of TRR (0.15 mg/kg) from hens treated with alcohol (phenyl)-^{14}C-bifenthrin.

In rats, goats and hens, excreta, faeces and urine were shown to be the major route of elimination of bifenthrin and its degradation products. Total radioactivity in excreta amounted in all animals to approximately 92–98% of all recovered radioactivity. Unchanged bifenthrin was the major residue in the milk and tissues of goat, in the egg yolk and tissues of poultry. Exceptions were goat kidney, where biphenyl acid was the major metabolite with unchanged bifenthrin second and poultry liver, where the TFP acid and fatty acid conjugates of hydroxyl-methyl-bifenthrin were the major residues.

The major routes of metabolism appear to consist in oxidation of one of the gem-dimethyl groups on the cyclopropyl ring to give OH-methyl derivatives, either before or after hydrolysis to TFP

acid and biphenyl alcohol and/or oxidation of the biphenyl group. Some of the oxidized or acid derivatives become conjugated.

Although there are qualitative similarities, there appear to be differences, primarily quantitative, between rat, goat and poultry metabolism. In rats and goats the major metabolites result from biphenyl ring oxidation. In poultry the oxidation of the dimethyl-cyclopropane group followed by the formation of fatty acid conjugates with oleic or palmitic acid is the major metabolic pathway which is different from the findings in rats and goats.

Plant metabolism

The metabolism of bifenthrin has been studied on apple (treatment of leaves and fruit surface), potato (treatment of soil, leaves), cotton (treatment of seeds, leaves, soil) and maize (treatment of leaves, husks, soil).

Apple fruits treated with [^{14}C]-bifenthrin (CP label) at a rate equivalent to approximately 24 g ai/hL were harvested and analysed 0, 7, 14 and 21 days following treatment. Most of the residue (> 85%) remained on the peel with little present in the pulp (2–16%, possibly due to contamination during peeling). At 21 days, 93% of the TRR in the whole apple (pulp and peel) was parent bifenthrin.

Apple leaves treated with [^{14}C]-bifenthrin (CP and PH label) were harvested and analysed 29 days following treatment. Bifenthrin accounted for 84–88% of the TRR, and biphenyl acid (2.6%) was detected as a metabolite from the PH label.

Bifenthrin metabolism in potato was studied using [^{14}C]-bifenthrin (CP and PH label). It was applied to soil in-furrow at planting and twice foliar to greenhouse-grown potatoes. The application regimen was designed to simulate a field-like application where the soil was treated at the rate of about 0.34 kg ai/ha at the time of planting followed by two foliar applications each at about 0.11 kg ai/ha at 28 and 14 days pre-harvest interval for a total of 0.56 kg ai/ha. The TRR in the mature foliage for CP and PH labels was 2.7 and 1.94 mg/kg, respectively. The TRR in the tubers from the CP and PH labels was very low, < 0.05 mg/kg at 0.047 and 0.038 mg/kg, respectively, indicating radioactivity in the tubers was not significant. Levels of bifenthrin in tubers were negligible from both labels and ranged between 0.031 mg/kg to 0.034 mg/kg for both labels. It also showed very negligible residues of bifenthrin plant metabolites including 4'-OH-bifenthrin, TFP acid, biphenyl alcohol, biphenyl acid, and biphenyl aldehyde none of which reached 0.001 mg/kg. It was concluded that when bifenthrin is applied foliar to leaves or in furrows, very limited translocation of bifenthrin from either leaf or soil to tubers took place. Parent bifenthrin was the major residue in tubers (73–81% of TRR) and was below 0.035 mg/kg.

Three-week old cotton plants were treated with [^{14}C]-bifenthrin (PH label) either by soil application or by treatment of individual leaves. In all cases essentially no radiocarbon was present in untreated leaves, stems, boll husks, lint and seeds. This indicates that there is essentially no translocation of bifenthrin or metabolite from soil or treated leaves into other portions of the plant through maturity. The metabolite profile indicated that biphenyl alcohol, biphenyl acid and TFP acid account individually for less than 1% of the TRR. Six unidentified metabolites were detected with no single metabolite exceeding 5% of the total residue.

In a second study cotton plants were treated individually with [^{14}C]-bifenthrin (PH label) at a rate of 1.3 µg/seed. Parent bifenthrin made was the main product identified (approximately 83–95% the total ^{14}C-residue). In the 28-day sample, 9% of the residue was not extractable. Other metabolites (up to six minor products) had reached 8% of the total residue in the 28-day sample. ^{14}C-residues in untreated bolls from the treated plants were negligible (not detected in lint, seed, stem, 0.08% in bolls, 0.07% in leaves) indicating that bifenthrin does not translocate from treated cottonseeds to other parts of the plant.

The metabolism study on maize demonstrates that bifenthrin is essentially non-systemic when applied either post-emergence to the soil or when applied as a dilute formulation to the leaves and husks of young maize plants. Bifenthrin on treated leaves degrades only to a minor extent. The major

metabolite is 4'-hydroxy-bifenthrin, which comprises 11% of the TRR one month after foliar treatment.

In summary, the results of the different bifenthrin plant metabolism studies are consistent: unchanged and unconjugated bifenthrin was shown to be the predominant residue in plants. No cis- to trans-isomerisation was observed in the course of the studies. Studies on apple fruits and leaves, or either by soil application or by treatment of individual leaves on potatoes, cotton and maize show that bifenthrin is essentially non-systemic. Only little translocation from treated soils or plant parts to untreated parts of the plant was observed.

Environmental fate in soil

The Meeting received information on soil aerobic metabolism, soil photolysis, hydrolysis and crop rotation properties of bifenthrin.

In a series of aerobic soil metabolism studies at 25 °C with [^{14}C]-bifenthrin (CP- and PH-label), the percentage parent remaining after 120–180 days was 28–55% of dose (n = 8). The half-lives ranged for CP-^{14}C-bifenthrin from 50 to 205 days and for PH-^{14}C-bifenthrin from 69 to 135 days, depending on soil type. It can be concluded, that parent compound is the only relevant residue for quantification in soil. The main metabolite, 4'-OH-bifenthrin, is always found in amounts generally lower than 10% of TRR, other metabolites such as TFP acid, biphenyl alcohol or biphenyl acid mostly occurred in traces only.

The measured half-lives for bifenthrin in two soil surface photolysis studies were 84 and 124 days. No major metabolite was formed, TFP acid reflecting the most predominant identifiable minor metabolite peaking at 3.8% on day 30.

Because of the highly insoluble nature of bifenthrin in water, no hydrolysis of the compound occurred at any of the pH tested (5.05, 7.08, 8.97).

In a confined rotational crop study with lettuce, sugar beet and wheat, soil was spiked with [^{14}C]-bifenthrin (CP- and PH-label), at the equivalent of 0.56 kg ai/ha. The crops were sown at 30, 60 and 120 days later. The maximum TRR (as bifenthrin equivalents) were 0.029 mg/kg in lettuce, 0.065 mg/kg in sugar beets (whole plant) and 0.053 mg/kg in wheat (whole plant). In wheat grain, TRR up to 0.049 mg/kg were determined. In wheat straw, higher TRR up to 0.31 mg/kg were detected.

In a second confined rotational study, only wheat was sowed 30 days, 120 days, 7 months and 12 months following application of [^{14}C]-bifenthrin (CP- and PH-label) at the equivalent of 0.56 kg ai/ha to the soil. Bifenthrin was present in the 30-day straw at 0.064–0.12 mg/kg. The 120 day straw samples had levels of 0.022 mg/kg bifenthrin, and even lower values were found from the 7 and 12 month sowings. The results of those studies are comparable and demonstrated that the translocation of bifenthrin residues is very low.

The residue data from a field crop rotation study showed that wheat planted 30 to 32 days after harvest of a primary crop (cotton, maize or sweet corn) treated with total 0.56 kg ai/ha yielded no bifenthrin residues. This adequately supports the fact that residues in soils resulting from recommended uses should not contribute to the residues in succeeding crops.

Methods of analysis

The Meeting received descriptions and validation data for analytical methods for residues of bifenthrin in plant and animal commodities.

Residue analytical methods for bifenthrin rely on GC-ECD and GC-MSD. Typical LOQs achieved for plant and animal commodities fall in the range of 0.01–0.05 mg/kg. Methods have been subjected to independent laboratory validation.

Stability of residues in stored analytical samples

Information was received on the freezer storage stability of bifenthrin residues in plant and animal commodities. Residues were apparently stable at freezer temperature for the intervals tested.

Definition of the residue

The parent compound bifenthrin is the dominant component of the residue in plant commodities.

Unchanged bifenthrin was the major residue in the milk and tissues of goat, in the egg yolk and tissues of poultry. Exceptions were goat kidney, where biphenyl acid was the major metabolite with unchanged bifenthrin second and poultry liver, where the TFP acid and fatty acid conjugates of hydroxyl-methyl-bifenthrin were the major residues. The Meeting noted that the only compound of toxicological relevance in animal commodities is bifenthrin.

Therefore, from the metabolism studies on plants and animals presented, the proposed definition of the residue is parent bifenthrin only.

In animal metabolism and feeding studies, bifenthrin displays the properties of a fat-soluble compound.

Definition of the residue (for compliance with the MRL and for estimation of dietary intake) for plant and animal commodities: *bifenthrin (sum of isomers)*.

The residue is fat-soluble.

Results of supervised trials on crops

Supervised trials were available on the following crops: oranges, grapefruit, lemons, raspberries, blackberries, bananas, mangos, papaya, Brussels sprouts, head cabbage, cauliflower, egg plant, peppers, okra, sweet corn, tomatoes, mustard greens, green beans, peas, beans (pulses), peas (pulses), soya beans (pulses), carrots, potatoes, radish, sugar beet, barley, maize, oats, triticale, wheat, tree nuts, cotton, rape, hops and tea.

The NAFTA calculator was used as a tool in the estimation of the maximum residue level from the selected residue data set obtained from trials conducted according to GAP. As a first step, the Meeting reviewed all relevant factors related to each data set in arriving at a best estimate of the maximum residue level using expert judgement. Then, the NAFTA calculator was employed. If the statistical calculation spreadsheet suggested a different value from that recommended by the JMPR, a brief explanation of the deviation was provided. Some common factors that may lead to rejection of the statistical estimate include those situations where the number of data points is less than 15 or where there are too many values below LOQ.

Citrus fruits

Supervised trials were available for lemon, oranges and grapefruit from Brazil and the USA. Furthermore, residue data were submitted from Italy and Spain, but currently no registered use exists in the European Union.

In Brazil, bifenthrin is registered for foliar spray use on citrus fruits at an application rate of 0.014–0.036 kg ai/ha with a PHI of 7 days. One trial each on lemon and oranges is matching the maximum GAP (0.038 kg ai/ha, 7 days PHI). The residues were < 0.05 and 0.05 mg/kg.

In the USA, bifenthrin is registered by ground application to bare soil beneath citrus trees at a rate of 0.11–0.56 kg ai/ha and a PHI of 1 day. In 36 US trials in line with GAP, seven on lemon, 21 on oranges and eight on grapefruit, the residues were: < 0.005, 0.0082, < 0.05 mg/kg (34).

The Meeting estimated a maximum residue level, an STMR and an HR of 0.05 mg/kg for citrus fruits. The previous recommendation of 0.05* mg/kg for grapefruit, lemon and oranges is withdrawn.

Statistical calculations were not possible, since most of the values are below the LOQ.

Pear

Bifenthrin is registered for foliar spray treatment on pears in Australia with 0.0025–0.004 kg ai/hL (PHI 14 days) and in Japan with 0.001–0.002 kg ai/hL (PHI 1 day). No residue data for pears were submitted.

The Meeting withdrew the previous recommendation of 0.5 mg/kg for pear.

Berries and other small fruits

Supervised trials were available for raspberries, blackberries and strawberries from the USA. Furthermore, residue data on strawberries were submitted from Belgium, France, Italy, the Netherlands, Poland, Spain and the UK, but currently no registered use exists in the European Union.

Caneberries

In the USA, bifenthrin may be used as foliar spray on caneberries (blackberry, dewberry, loganberry and raspberry) with an application rate of 2 × 0.056–0.11 kg ai/ha and a PHI of 3 days.

Five US trials (four on raspberries, one on blackberries) were carried out according to GAP. The residues in ranked order were: < 0.05, 0.25, 0.29, 0.34 and 0.51 mg/kg.

The Meeting estimated a maximum residue level, an STMR and an HR for bifenthrin in blackberries, dewberries (including boysenberry and loganberry) and raspberries (red, black) of 1 mg/kg, 0.29 mg/kg and 0.51 mg/kg, respectively.

The maximum residue level estimate derived from use of the NAFTA statistical calculator was 0.81 mg/kg, which when rounded up, was in agreement with the Meeting's estimation.

Strawberry

Bifenthrin is registered in the USA for foliar spray use on strawberries at an application rate of 0.045–0.22 kg ai/ha, maximum 0.56 kg ai/ha per season (PHI not specified).

One US trial was conducted with 2 spray applications (interval 14 days) of 0.22 kg ai/ha resulting in a residue of 0.59 mg/kg at the day of the treatment.

Eighteen US trials were carried out with 4 spray treatments (interval 14 days) of 0.22 kg ai/ha. The maximum application rate of 0.56 kg ai/ha per season was exceeded (0.88 kg ai/ha). Samples were taken at 0, 1, 3 and 5 days. Because no PHI is specified, the highest value of each trial from all sampling days was selected.

The Meeting noted that the number of applications is not relevant because of the large treatment interval of 14 days and used all US trials for the evaluation. The residues, in ranked order, were (n = 19): 0.27, 0.30, 0.31, 0.33, 0.33, 0.34, 0.34, 0.36, 0.41, 0.46, 0.46, 0.48, 0.51, 0.59, 0.86, 0.86, 0.88, 2.1 and 2.3 mg/kg.

The Meeting estimated a maximum residue level for bifenthrin in strawberries of 3 mg/kg to replace the previous recommendation of 1 mg/kg. The Meeting estimated an STMR of 0.46 mg/kg and an HR of 2.3 mg/kg.

The maximum residue level estimate derived from use of the NAFTA statistical calculator was 2.39 mg/kg, which when rounded up, was in agreement with the Meeting's estimation.

The Meeting noted that the ARfD is exceeded for children (430%) and the general population (230%) by the dietary intake calculation. No alternative GAP is available.

Assorted tropical and sub-tropical fruits – inedible peel

Supervised trials were available for banana from France, Puerto Rico, Spain and the USA. Data for mango and papaya were submitted as part of the field trials conducted within the Pesticide Initiative Programme aiming to provide data for establishing import MRLs in the European Union.

Banana

In Central America (Columbia, Costa Rica, Ecuador, Guatemala, Honduras, Panama), tree bags with 1% bifenthrin are placed over the banana bunch before flower stalk shows first hand until harvest.

Four trials from France (Martinique) and two from Spain (Canary Islands) in line with Central American GAP showed from 1–132 days no residues in the pulp (< 0.01 mg/kg, n = 6); data on whole fruit were not submitted.

Samples were taken after 43–112 days in six trials from Puerto Rico and three from the USA. No residues were detected in the pulp (< 0.01 mg/kg, n = 9). In the whole fruits, the residues were: < 0.05 (7), 0.057 and 0.074 mg/kg.

The Meeting estimated a maximum residue level of 0.1 mg/kg for bifenthrin in banana. Based on data on pulp, the Meeting estimated an STMR and an HR of 0.01 mg/kg.

Statistical calculations were not possible, as the majority of the values were below the LOQ.

Mango

Bifenthrin was applied as foliar spray treatment with 0.05 kg ai/ha and a PHI of 7 days in two trials each in Mali and Senegal. The application conditions were based on the requirement of appropriate control of diseases of mango, but they were not supported by label or official declaration of approved use.

The residues in whole fruit were: 0.066, 0.13, 0.15 and 0.23 mg/kg. In two trials, peel and pulp from day 7 an 14 were analysed separately. No residues were found in flesh (< 0.01 mg/kg).

The Meeting estimated a maximum residue level for bifenthrin in mango of 0.5 mg/kg. The estimated STMR and HR values were 0.01 mg/kg.

The maximum residue level estimate derived from use of the NAFTA statistical calculator was 0.44 mg/kg, which when rounded up, was in agreement with the Meeting's estimation.

Papaya

Bifenthrin was applied as foliar spray treatment with 4 × 0.05 kg ai/ha and a PHI of 3 days in eight trials carried out in Ghana and the Ivory Cost. The application conditions were apparently based on the requirement to achieve appropriate disease control in papaya. However, the data provided was not supported by a label or official declaration indicating the use had regulatory approval.

The residues in whole fruit were (n = 8): 0.095, 0.13, 0.13, 0.14, 0.16, 0.17, 0.20 and 0.30 mg/kg.

No residue data for the edible portion were available. Nevertheless, taking into account the results of the apple fruit metabolism study showing that more than 85% of the residue remained on the peel and that no residues were found in supervised residue trials in pulp of banana and mango, the Meeting concluded that no residues higher than 0.01 mg/kg are expected in papaya edible portion.

The Meeting estimated for bifenthrin in papaya a maximum residue level of 0.4 mg/kg and STMR and an HR of 0.0.1 mg/kg.

The maximum residue level estimate derived from use of the NAFTA statistical calculator was 0.35 mg/kg, which when rounded up, was in agreement with the Meeting's estimation.

Brassica vegetables

Supervised trials were available for head cabbage and cauliflower from Japan and the USA. Furthermore, residue data on Brussels sprouts, head cabbage and cauliflower were submitted from France, Germany, Italy, the Netherlands, Poland and the UK, but currently no registered use exists in the European Union.

The registered use of bifenthrin in brassica vegetables in the USA is foliar spray treatment of 5 × 0.034–0.11 kg ai/ha and a PHI of 7 days or as soil treatment in-furrow at seeding or at transplant with 0.06–0.11 kg ai/ha.

Trials on head cabbage were carried out in the USA, three of them were in line with the US GAP (5 × 0.11 kg ai/ha, PHI 7 days). The treatment interval was 7 days. Two further trials had the same treatment rate and PHI, but higher application numbers of 8 and 11. In these trials, cool, wet weather resulted in much slower growth of the plants than expected. In order to collect mature-sized cabbages and to maintain a PHI of 7 days, spraying at weekly intervals was continued. The Meeting noted that the earlier sprays do not influence the terminal residues and considered these trials also as being in GAP. The residues were < 0.04, < 0.04, < 0.04, < 0.05 and 0.19 mg/kg in cabbage without wrapper leaves. In cabbage with wrapper leaves the residues were 0.70, 0.82, 1.5, 2.3 and 3.1 mg/kg which are relevant for animal dietary burden estimation.

Ten trials on cauliflower were carried out in the USA, four of them were in line with the US GAP (5 × 0.11 kg ai/ha, PHI 7 days). The residues were < 0.05, 0.09, 0.14 and 0.19 mg/kg.

Based on the data for cauliflower, the Meeting estimated a maximum residue level, an STMR and an HR of 0.4, 0.115 and 0.19 mg/kg for brassica vegetables.

Based on the data for head cabbage with wrapper leaves, an STMR of 1.5 mg/kg and a highest residue of 3.1 mg/kg were estimated for animal dietary burden calculation.

The maximum residue level estimate derived from use of the NAFTA statistical calculator was 0.4 mg/kg, which was in agreement with the Meeting's estimation.

Fruiting vegetables, other than Cucurbits

Supervised trials were available for egg plant, peppers, sweet corn and tomato from the USA and European countries as well as for okra from Ivory Coast. No GAP exists currently in the European Union for the use of bifenthrin in fruiting vegetables.

Peppers

The registered use of bifenthrin in peppers in the USA is foliar spray treatment 0.022–0.11 kg ai/ha and a PHI of 7 days. Eleven US trials in line with US GAP were available. The residues were in rank order (n = 11) were: < 0.055, 0.07, 0.09, 0.10, 0.11, 0.14, 0.17, 0.21, 0.23, 0.24 and 0.31 mg/kg.

The Meeting estimated for bifenthrin residues in peppers a maximum residue level, an STMR and an HR of 0.5 mg/kg, 0.14 mg/kg and 0.31 mg/kg, respectively.

The maximum residue level estimate derived from use of the NAFTA statistical calculator was 0.5 mg/kg, which was in agreement with the Meeting's estimation.

Okra

As part of the field trials conducted within the Pesticide Initiative Programme aiming to provide data for establishing import MRLs in the European Union, bifenthrin was applied as foliar spray treatment with 2 × 0.05 kg ai/ha and a PHI of 2 days in four trials in Ivory Cost. The application conditions were based on the requirement of appropriate control of diseases of okra, but they were not supported by label or official declaration of approved use. The residues were 0.04, 0.05, 0.09 and 0.11 mg/kg.

The Meeting estimated for bifenthrin residues in okra a maximum residue level, an STMR and an HR of 0.2 mg/kg, 0.07 mg/kg and 0.11 mg/kg, respectively.

The maximum residue level estimate derived from use of the NAFTA statistical calculator was 0.2 mg/kg, which was in agreement with the Meeting's estimation.

Sweet corn

The registered use of bifenthrin in sweet corn in the USA is foliar treatment with 0.036–0.11 kg ai/ha (max. 0.34 kg ai/ha per season) and a PHI of 1 day. Thirteen US trials treated with 0.09, 0.09 and 0.04 kg ai/ha showed residues of < 0.05 mg/kg at one day after the last application, but did not match the critical GAP.

The Meeting was not able to estimate a maximum residue level for bifenthrin residues in sweet corn.

Tomato

The registered use of bifenthrin in tomato in the USA is foliar spray treatment 0.022–0.11 kg ai/ha and a PHI of 1 day. None of the 22 US trials submitted was in line with critical US GAP because the samples were taken later than the PHI of 1 day.

In Mexico, bifenthrin is registered as foliar spray treatment of 0.06 kg ai/ha and a PHI of 1 day. Seven outdoor trials according to GAP were received. The residues were 0.03, 0.04, 0.06, 0.06, 0.09, 0.15 and 0.15 mg/kg.

The Meeting estimated a maximum residue level, an STMR and an HR of 0.3 mg/kg, 0.06 mg/kg and 0.15 mg/kg, respectively, for bifenthrin residues in tomatoes.

The maximum residue level estimate derived from use of the NAFTA statistical calculator was 0.3 mg/kg, which was in agreement with the Meeting's estimation.

Egg plant

The registered use of bifenthrin in eggplant in the USA is foliar spray treatment 0.034–0.11 kg ai/ha and a PHI of 7 days. Three US trials in line with US GAP were available. The residues were < 0.05 mg/kg (3). The Meeting noted that three trials are not sufficient to estimate a maximum residue level.

Six trials from the USA on tomato were available carried out about according to the GAP for eggplant (4 × 0.09 kg ai/ha, PHI 6–7 days). The residues in tomatoes were: < 0.05 (4), 0.07 and 0.10 mg/kg.

The Meeting concluded to use the trials on tomatoes to estimate a maximum residue level, an STMR and an HR of 0.3 mg/kg, 0.05 mg/kg and 0.10 mg/kg, respectively, for bifenthrin residues in eggplant.

Statistical calculations were not possible, since most of the values are below the LOQ.

Leafy vegetables (incl. brassica leafy vegetables)

Supervised trials on leafy vegetables were available for mustard greens and radish leaves and tops from the USA.

The registered use of bifenthrin in brassica leafy vegetables in the USA is foliar spray treatment of 0.037–0.11 kg ai/ha and a PHI of 7 days.

Eight US trials on mustards greens in line with US GAP were available. The residues were in rank order (n = 8): 0.08, 0.19, 0.85, 0.91, 1.4, 1.9, 1.9 and 2.1 mg/kg.

The Meeting estimated for bifenthrin residues in mustard greens a maximum residue level, an STMR and an HR of 4 mg/kg, 1.16 mg/kg and 2.1 mg/kg, respectively.

The maximum residue level estimate derived from use of the NAFTA statistical calculator was 3.52 mg/kg (mean +3SD), which when rounded up, was in agreement with the Meeting's estimation.

Six US trials on radish leaves and tops in line with US GAP for leafy vegetables were available. The residues were in rank order (n = 6): 0.69, 1.2, 1.7, 1.8, 2.0 and 2.3 mg/kg.

The Meeting estimated for bifenthrin residues in radish leaves and tops a maximum residue level, an STMR and an HR of 4 mg/kg, 1.75 mg/kg and 2.3 mg/kg, respectively.

The maximum residue level estimate derived from use of the NAFTA statistical calculator was 4.19 mg/kg, which was in agreement with the Meeting's estimation.

Legume vegetables

Supervised trials on legume vegetables were available for green beans and peas from European countries and the USA. None of the trials submitted was in line with the GAP.

The Meeting was not able to estimate a maximum residue level for bifenthrin in legume vegetables.

Pulses

Supervised trials on pulses were available for dry beans and soya beans from the USA as well as for dry peas from Denmark, France, Germany, Poland, Sweden and the UK, but currently no registered use exists in the European Union.

Bifenthrin is registered on beans and peas in the USA with 0.028–0.11 kg ai/ha and a PHI of 14 days. Nine US trials matching the GAP showed residues in dried beans of < 0.05 (6), 0.07, 0.10 and 0.10 mg/kg. Residues in dried peas were < 0.05 mg/kg (6) in six US trials matching the GAP.

For soya beans, the US GAP is 0.028–0.11 kg ai/ha and a PHI of 18 days. The residues were in 15 US trials in line with US GAP (n = 15): < 0.05 (13), 0.07 and 0.18 mg/kg.

Based on the soya bean data, the Meeting estimated for bifenthrin residues in pulses a maximum residue level and an STMR of 0.3 mg/kg and 0.05 mg/kg, respectively.

Statistical calculations were not possible, since 13 from 15 residue values are below the LOQ.

Root and tuber vegetables

Supervised trials on root and tuber vegetables were available for carrots from European countries and the USA; for potatoes from Brazil, European countries and the USA; for radish from the USA and for sugar beet from France. Currently no registered use exists in the European Union.

The US GAP allows the foliar spray treatment of 0.09–0.11 kg ai/ha with a PHI of 21 days on root and tuber vegetables. In ten US trials on carrots matching US foliar spray GAP, the residues were in roots < 0.05 mg/kg (10).

In 17 US trials on potatoes matching US foliar spray GAP for root and tuber vegetables, the residues were in tubers < 0.05 mg/kg (17).

Bifenthrin is registered on potatoes in Brazil for soil treatment with 0.1 kg ai/ha and a PHI of 35 days. Three residue supervised trials each were carried out with 0.15 and 0.30 kg ai/ha (PHI 35 days). In all trials the residues were lower than the LOQ: < 0.02 mg/kg (6).

The Meeting estimated a maximum residue level, an STMR and an HR of for bifenthrin in root and tuber vegetables of 0.05 mg/kg.

Statistical calculations were not possible, since all levels are below the LOQ.

Cereal grains

Supervised trials on cereal grains were available for maize from the USA, for wheat after treatment at storage from the European countries and Brazil as well as for barley, oat, triticale and wheat after foliar spray application from European countries, but currently no registered uses exist in the European Union.

The previous recommendation for bifenthrin on barley of 0.05* mg/kg was withdrawn.

Wheat – storage treatment

The registered GAP on stored wheat grain in Brazil is 0.0004 kg ai/ton (withholding period 30 days). One Brazilian trial was in GAP and shows residues of 0.2 mg/kg.

The Meeting received 11 trials from Belgium, France and the UK treated with 0.0003 kg ai/ton (withholding period 30 days). The residues were 0.19, 0.21, 0.22, 0.23, 0.24, 0.25, 0.26, 0.27, 0.28, 0.28 and 0.29 mg/kg. In one further trial from the UK treated with 0.0005 kg ai/ton the residues were 0.40 mg/kg.

The Meeting noted that the storage treatment of the European trials was in line with the Brazilian GAP (±25%) and could be used for the evaluation. The residues of one Brazilian and twelve European trials, in ranked order, were (n = 13): 0.19, 0.20, 0.21, 0.22, 0.23, 0.24, 0.25, 0.26, 0.27, 0.28, 0.28, 0.29 and 0.40 mg/kg.

Based on the European data and Brazilian GAP for stored wheat grain, the Meeting estimated a maximum residue level of 0.5 mg/kg Po for wheat and confirmed the previous recommendation. The STMR and the HR were 0.25 mg/kg and 0.40 mg/kg, respectively.

The maximum residue level estimate derived from use of the NAFTA statistical calculator was 0.39 mg/kg. However, in order to cover residues in wheat after post harvest use, a higher maximum residue level was necessary.

Maize

Bifenthrin is registered on maize in the USA as foliar spray treatment with 0.11 kg ai/ha and a PHI of 30 days. The Meeting received the following residue data from US trials:

- Seven trials treated with 5 × 0.11 kg ai/ha, PHI 29–38 days: < 0.05 mg/kg (7)
- 18 trials treated with 5 × 0.11, kg ai/ha, PHI 39–68 days: < 0.05 mg/kg (18)
- Five overdosed trials treated 4 × 0.11 and 1 × 1.1 kg ai/ha, PHI 31, 33, 39, 54, 65 days: < 0.05 mg/kg (5).

The Meeting estimated a maximum residue level of 0.05* mg/kg for bifenthrin residues in maize and confirmed its previous recommendation. An STMR of 0 mg/kg was derived.

Statistical calculations were not possible, since all levels are below the LOQ.

Tree nuts

Supervised trials on tree nuts were available from the USA. The registered GAP on tree nuts in the USA is foliar spray treatment with 0.056–0.22 kg ai/ha. The PHI is 21 days for pecans and 7 days for others. The Meeting received 30 US trials treated 3 - 8 times with 0.22 kg ai/ha:

- 12 trials on walnuts, PHI 7 days, residues in meat: < 0.05 mg/kg (12)
- Six trials on filberts, PHI 14 days, residues in meat: < 0.05 mg/kg (6)
- 12 trials on pecans, PHI 21–23 days, residues in meat: < 0.05 mg/kg (12).

The Meeting estimated a maximum residue level, an STMR and an HR for tree nuts of 0.05 mg/kg.

Statistical calculations were not possible, since all levels are below the LOQ.

Oilseed

Supervised trials on oil seed were available from Brazil, Canada and the USA with data on cotton seed and rape seed. Furthermore, for cotton seed data from Greece and Spain as well as for rape seed from Germany, Poland and the UK were submitted, but currently no registered use exists in the European Union.

Cotton seed

Bifenthrin is registered in Brazil on cotton with 5 × 0.03 - 0.1 kg a/ha and a PHI of 15 days. Two Brazilian trials were matching the critical GAP. The residues were 0.02 and 0.07 mg/kg.

In the USA, Bifenthrin is registered with 0.11 kg ai/ha (maximum 0.56 kg ai/ha per season) and a PHI of 14 days. The Meeting received US trials treated with 0.1–0.11 kg ai/ha and a PHI of 14 days. Different application numbers in an interval of 7 days were used. The residues were after 3–11 treatments with 0.1–0.11 kg ai/ha (n = 21): < 0.05 (14), 0.06, 0.06, 0.07, 0.07, 0.13, 0.17 and 0.37 mg/kg.

The Meeting estimated a maximum residue level and an STMR for bifenthrin in cotton seed of 0.5 mg/kg and 0.05 mg/kg, respectively.

The maximum residue level estimate derived from use of the NAFTA statistical calculator (after MLE[1]) was 0.34 mg/kg. However, in order to cover residues in cotton seed, a higher maximum residue level was necessary. The number of < LOQ values (13 in 21 trials, > 50%) reduces the reliability of the calculated result.

Rape seed

In the USA, bifenthrin may be used as foliar spray treatment with 0.036–0.045 kg ai/ha and a PHI of 35 days. Four US and two Canadian trials treated with 0.04 kg ai/ha and PHIs of 20–29 days were received. The residues were < 0.05 mg/kg (6).

The Meeting estimated a maximum residue level and an STMR for bifenthrin in rape seed of 0.05 mg/kg.

Statistical calculations were not possible, since all levels are below the LOQ.

Hops, dry

Supervised trials on hops were available from Germany, the UK and the USA. No GAP exists currently in the European Union.

In USA, bifenthrin is registered for use on hops at 0.056–0.11 kg ai/ha and a PHI of 14 days. Three US trials in line with GAP were submitted. The residues were in dried hops 0.85, 1.9 and 5.4 mg/kg.

The Meeting estimated for bifenthrin residues in hops, dry a maximum residue level of 20 mg/kg and an STMR of 1.9 mg/kg. The pervious recommendation of 10 mg/kg was withdrawn.

Statistical calculations for only three data points were not adequate.

Tea, green and black

Supervised trials on green and black tea (dry) were available from China, India, Indonesia and Japan.

In China, the registered use for bifenthrin in tea is foliar spray treatment at 0.0075–0.053 kg ai/ha and a PHI of 7 days. The Meeting received ten Chinese trials treated with 2 × 0.045–0.048 kg ai/ha and a PHI of 7 days which were considered still consistent with Chinese GAP. The residues were in dried tea in ranked order (n = 10): 0.04, 0.07, 0.08, 0.08, 0.08, 0.09, 0.09, 0.11, 1.2 and 4.3 mg/kg.

Three trials from India treated with 0.06 kg ai/ha and a PHI of 7 days were submitted. The application rate was in the limit of ± 25% of Chinese GAP. The residues were in dried tea 0.42, 5.1 and 5.9 mg/kg.

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[1] Note: MLE (Maximum Likelihood Estimate) is the NAFTA process that adjusts the data below LOQ to a lognormal distribution, by applying the distribution based on values at or above the LOQ

The GAP in Japan is 2 × 0.08 kg ai/ha and a PHI of 14 days. Three Japanese trials according to GAP were submitted. The residues were in dried tea 1.3, 5.2 and 18 mg/kg.

One Indian (1 × 0.08 kg ai/ha, PHI 14 days) and one Indonesian trial (0.06 and 0.10 kg ai/ha, PHI 10 days) were considered still consistent with Japanese GAP. The residues were in dried tea 0.47 and 4.6 mg/kg.

The Meeting agreed to use the Japanese trials supported by the results of the Indian and Indonesian trials to estimate a maximum residue level.

The Meeting estimated a maximum residue level and an STMR for bifenthrin in tea, green and black, of 30 mg/kg and 5.2 mg/kg, respectively.

Statistical calculations for only three data points were not adequate.

Primary animal feed commodities

Legume animal feeds

Supervised trials on peas were available from Germany and the UK with data on fodder and forage but no GAP was submitted.

Straw and fodder (dry) of cereal grains (except maize)

Supervised trials on cereals as barley, oats, triticale and wheat were available from European countries with data on straw but no GAP was available.

The Meeting decided to withdraw the previous recommendation for barley straw and fodder, dry and wheat straw and fodder, dry of 0.5 mg/kg.

Straw, fodder and forage of cereal grains (except maize)

Supervised trials on cereals as barley, oats, triticale and wheat were available from European countries with data on forage but no GAP was available.

Maize fodder and forage

Supervised trials on maize were available from the USA with data on fodder and forage.

Bifenthrin is registered on maize in the USA as foliar spray treatment with 0.11 kg ai/ha and a PHI of 30 days.

The Meeting received eight US trials treated with 5 × 0.11 kg ai/ha, PHI 29–39 days. The residues in maize straw (fresh weight) were (n = 8): 0.2, < 0.5, 1.3, 1.7, 1.9, 2.0, 2.7 and 4.6 mg/kg.

Based on 83% dry matter (*FAO Manual*, Table IX.2), the Meeting estimated a maximum residue level for maize fodder of 15 mg/kg (dry weight) to replace the previous recommendation of 0.2 mg/kg. The estimated STMR value was 2.2 mg/kg and the high residue level 5.5 mg/kg, respectively, based on dry weight.

The maximum residue level estimate derived from use of the NAFTA statistical calculator was 12.37 mg/kg (fresh weight) or 14.9 mg/kg (dry weight) which was in agreement with the Meeting's estimation.

The Meeting received 24 US trials on maize forage treated with 5 × 0.11 kg ai/ha, samples were taken 10–42 days after the last treatment. The residues in maize forage (fresh weight) were (n = 24): < 0.1, 0.14, 0.16, 0.23, 0.23, 0.29, 0.29, 0.39, 0.49, 0.49, 0.55, 0.57, 0.60, 0.60, 0.76, 0.85, 0.97, 0.97, 1.2, 1.3, 1.4, 1.5, 1.6 and 2.0 mg/kg.

The Meeting estimated STMR and highest residue values for maize forage (fresh weight) of 0.585 mg/kg and 2.0 mg/kg, respectively.

Almond hulls

Supervised trials on almond hulls were available from the USA.

The registered GAP on tree nuts in the USA is foliar spray treatment with 0.056–0.22 kg ai/ha. The Meeting received five US trials where the last treatment was with 0.06–0.11 kg ai/ha. The trials did not match the critical US GAP.

The trials could not used to support recommendations.

Fate of residues during processing

A nature of the residue under simulated processing conditions study was received. The hydrolysis of ^{14}C[phenyl ring] bifenthrin was studied at 90, 100, and 120 °C in sterile buffers. The radio labelled compound was applied to pH 4, 5, and 6 sterile aqueous buffer solutions at an application rate of 0.005 mg/L. The samples were incubated for 20 to 60 minutes at 90, 100, and 120 °C in the dark. The mean material balance was 100.3, 97.6, and 81.3% of the applied radioactivity for the pH 4, 5, and 6 tests, respectively. Under the sterile hydrolysis conditions of the study, bifenthrin was found to be hydrolytically stable at those pH levels.

The Meeting received information on the fate of bifenthrin residues during the processing of tomatoes to paste and puree; of maize to meal, flour, oil and wet milling starch; of soya beans to meal and oil; of cotton seed to oil and of hops to beer. Information is available on processing of wheat to flour, bred, bran and germ and of tea to tea water extract. A potato processing studies could not be used to derive processing factors, as the RAC contained no residues above LOQ and the processed fraction residues were below the LOQ.

The processing factors and the derived STMR-P values are summarised as follows:

RAC	Processed commodity	Calculated processing factors	PF (median or best estimate)	RAC STMR (HR)	STMR-P (HR-P)
Tomato	Paste	< 0.63, < 0.71	< 0.67 (mean)	0.06	0.04
	Puree	< 0.63, < 0.71	< 0.67 (mean)		0.04
Maize	Coarse meal	0.32	0.32	0	0
	Flour	1.1	1.1		0
	Grits	< 0.15	< 0.15		0
	Crude oil	0.77, 1.9	1.9 (highest)		0
	Refined oil	0.92, 2.3	2.3 (highest)		0
	Germ	0.29, 0.52	0.52 (highest)		0
	Hulls	2.9, 1.5	2.9 (highest)		0
	Starch	< 0.15	< 0.15		0
Soya bean	Hulls	1.2, 1.4	≥ 1.3		0.065
	Aspirated grain	140, 240	≥ 190 (mean)		9.5
Wheat	Bran	2.5, 2.6, 2.7, 2.7, 2.7, 2.9, 3.0, 3.0, 3.0, 3.1, 3.1, 3.2, 3.3, 3.3, 3.5, 3.5, 4.4, 4.6, 4.6, 5.0, 5.0, 5.1	3.15 (median, n = 22)	0.25 (0.40)	0.79 (1.26)
	Whole meal flour	0.29, 0.32, 0.37, 0.59, 0.63, 0.64, 0.68, 0.68, 0.69, 0.69, 0.70, 0.71, 0.73, 0.76, 0.76, 0.77, 0.77, 0.78, 0.79, 0.81, 0.81, 0.87, 0.88, 0.92, 0.95, 1.0, 1.0, 1.1, 1.1, 1.1	0.765 (median, n = 30)		0.19 (0.306)
	Whole meal bread	0.11, 0.11, 0.14, 0.15, 0.15, 0.18, 0.19, 0.19, 0.60, 0.69, 0.73, 0.76, 0.76, 0.81, 0.83, 0.85, 0.86, 0.87, 0.88, 0.88, 0.89, 0.97	0.75 (median, n = 22)		0.19 (0.3)
	White flour	0.038, 0.038, 0.071, 0.077, 0.21, 0.21, 0.24, 0.26, < 0.3, 0.3, 0.3, 0.32, 0.32, 0.32, 0.33, 0.34, 0.35, 0.39, 0.42, 0.47, 0.51, 0.52	0.31 (median, n=22)		0.078 (0.124)
	White flour bread	0.036, 0.037, 0.038, 0.038, 0.069, 0.071, 0.074, 0.077, 0.20, 0.24, 0.24, 0.25, 0.25, 0.25, 0.27, 0.28, < 0.29, < 0.30, 0.30, 0.31, < 0.32, 0.32	0.245 (median, n=22)		0.061 (0.098)

RAC	Processed commodity	Calculated processing factors	PF (median or best estimate)	RAC STMR (HR)	STMR-P (HR-P)
	Germ	1.1, 1.2, 1.5, 1.6, 2.0, 2.2, 2.5, 2.7	1.8 (median, n=8)		0.45 (0.72)
Cotton seed	Linters	4.5, 4.2	4.4 (mean)	0.05	0.22
	Hulls	0.27, 0.40	0.34 (mean)		0.017
	Meal	< 0.058, < 0.053	< 0.06 (highest)		0.003
	Refined oil	0.10, 0.084	0.1 (highest)		0.005
Rape seed	Meal	0.54	0.54	0.05	0.027
	Refined oil	1.6	1.6		0.08
Hops	Beer	< 0.0055, < 0.0057	< 0.006	1.9	0.011
Tea	Water extract	0.001, 0.0018, 0.002, 0.002, 0.0021, 0.0023, 0.0023, 0.0025, 0.0026, 0.0027, 0.0027, 0.003, 0.0035, 0.0043, < 0.005, 0.0062, < 0.007, 0.0077, < 0.011, 0.014, < 0.019, < 0.024	0.003 (median, n=22)	5.2	0.0156

On processing, bifenthrin concentrated in maize oil, rape seed oil, wheat germ, wheat bran and in milled by-products as hulls and aspirated grain fractions. The Meeting decided to estimate the following maximum residue levels, STMR-P and HR-P values for processed commodities:

Based on the STMR of 0.05 mg/kg for rape seed and a processing factor of 1.6, the Meeting estimated a maximum residue level of 0.1 mg/kg and an STMR-P of 0.08 mg/kg for rape seed oil, edible.

Based on an HR for wheat of 0.4 mg/kg Po, an STMR of 0.25 mg/kg Po and a processing factor of 1.8, the Meeting estimated a maximum residue level of 1 mg/kg PoP, a STMR-P of 0.45 mg/kg PoP and an HR-P of 0.72 mg/kg PoP for wheat germ.

Based on an HR for wheat of 0.4 mg/kg Po, an STMR of 0.25 mg/kg Po, an HR and a processing factor of 3.15, the Meeting estimated a maximum residue level of 2 mg/kg PoP, an STMR-P of 0.79 mg/kg PoP and an HR-P of 1.26 mg/kg PoP for wheat bran, unprocessed. The previous recommendation was confirmed.

The Meeting was aware that bifenthrin residues concentrated during processing of maize to maize oil. Because the STMR in maize grain is 0 mg/kg, residues in maize oil are not expected above the maximum residue level of 0.05* mg/kg for maize grain. The Meeting estimated an STMR of 0 for maize oil, edible and maize oil, crude, maize flour, maize grits and maize starch.

The Meeting also decided to estimate a maximum residue for chilli pepper (dried) of 5 mg/kg following application of a default dehydration factor of 10 to the estimated maximum residue level of 0.5 mg/kg for sweet pepper (10 × 0.5 = 5 mg/kg). The STMR for residues of bifenthrin in chilli peppers (dry) is estimated to be 10 × 0.14 = 1.4 mg/kg.

Residues in animal commodities

Farm animal dietary burden

The Meeting estimated the dietary burden of bifenthrin in farm animals on the basis of the diets listed in Appendix X of the FAO Manual (OECD Feedstuffs Derived from Field Crops). Calculation from highest residue, STMR (some bulk commodities) and STMR-P values provides the levels in feed suitable for estimating MRLs, while calculation from STMR and STMR-P values for feed is suitable for estimating STMR values for animal commodities. Dietary burden calculations for beef cattle, dairy cattle, broilers and laying poultry are provided in Annex 6 of the 2010 JMPR Report.

	Livestock dietary burden, bifenthrin, ppm of dry matter diet							
	US/CAN		EU		Australia		Japan	
	max	mean	max	mean	max	mean	max	mean
Beef cattle	1.85	1.35	**8.26** [a]	**3.35** [b]	5.2	1.76	0.57	0.57

Dairy cattle	2.68	1.12	**7.41** [c]	**3.21** [d]	5.2	1.76	2.92	1.15
Poultry - broiler	0.59	0.59	0.43	0.43	0.38	0.38	0.11	0.11
Poultry - layer	0.59	0.59	**1.97** [e]	**1.10** [f]	0.35	0.35	0.28	0.28

[a] Highest maximum beef or dairy cattle burden suitable for MRL estimates for mammalian meat

[b] Highest mean beef or dairy cattle dietary burden suitable for STMR estimates for mammalian meat.

[c] Highest maximum dairy cattle dietary burden suitable for MRL estimates for milk.

[d] Highest mean dairy cattle dietary burden suitable for STMR estimates for milk.

[e] Highest maximum poultry dietary burden suitable for MRL estimates for poultry meat and eggs.

[f] Highest mean poultry dietary burden suitable for STMR estimates for poultry meat and eggs.

Farm animal feeding studies

The Meeting received information on the residue levels arising in animal tissues and milk when dairy cows were dosed daily with bifenthrin for 28 days at the equivalent of 0.5, 5, 15 and 50 ppm in the diet. Average residues of bifenthrin in milk for the 5, 15 and 50 ppm dose group were 0.082, 0.15 and 0.65 mg/kg, respectively. Residues in tissues were:

- In the 5 ppm dose group, no residues of bifenthrin above the LOQ of 0.1 mg/kg were detected in muscle, kidney and liver; in fat, the highest residue was 1.7 mg/kg and the mean 0.865 mg/kg.
- In the 15 ppm dose group, the highest residues in muscle, liver, kidney and fat were 0.24, < 0.1, 0.19, and 2.2 mg/kg, respectively. The mean residues in muscle, liver, kidney and fat were 0.154, < 0.1, 0.185 and 1.325 mg/kg.
- In the 50 ppm dose group, the highest residues in muscle, liver, kidney and fat were 0.88, < 0.1, 0.49 and 5.8 mg/kg, respectively. The mean residues in muscle, liver, kidney and fat were 0.37, < 0.1, 0.465 and 3.45 mg/kg.

In a second study, dairy cows were dosed with bifenthrin at levels of 5 and 50 ppm per day for 28 consecutive days. Milk fat was analysed for parent bifenthrin. Additional, milk and tissues were analysed for biphenyl alcohol and tissues for biphenyl acid. The results were:

- Bifenthrin mean residues in milk fat were 0.765 mg/kg in the 5 ppm dose group and 8.81 mg/kg in the 50 ppm dose group.
- Residues of the metabolite biphenyl alcohol were in milk < 0.02 mg/kg of the 50 ppm dose group.
- In tissues, in the 5 ppm dose group, the highest residues of biphenyl alcohol in muscle, liver and kidney were < 0.05 mg/kg and in fat 0.11 mg/kg. The mean residues in muscle, liver, kidney were < 0.05 mg/kg and 0.067 mg/kg in fat.
- In tissues, in the 50 ppm dose group, the highest residues of biphenyl alcohol in muscle, liver, kidney and fat were 0.07, < 0.05, < 0.05 and 1.1 mg/kg, respectively. The mean residues in muscle, liver, kidney were < 0.05 mg/kg and 0.067 mg/kg in fat.
- Residues of the metabolite biphenyl acid were at the 50 ppm feeding level in muscle and fat < 0.05 mg/kg. Highest residues were in liver 0.05 mg/kg and in kidney 0.14 mg/kg. Mean residues were in liver 0.045 mg/kg and in kidney 0.09 mg/kg.

In a third study, dairy cows were dosed with bifenthrin at levels of 5 and 50 ppm per day for 28 consecutive days. Tissue samples of peritoneal fat and subcutaneous fat were analysed for 4'-hydroxy-bifenthrin. No detectable (< 0.01 mg/kg) 4'-hydroxy-bifenthrin residue was found in any of the cow fat samples analysed.

The Meeting also received information on the residue levels arising in tissues and eggs when laying hens were dosed with bifenthrin for 28 days at levels equivalent to 0.0025, 0.025 and 0.25 ppm in the diet. At the high dose residues of bifenthrin and 4'-hydroxy-bifenthrin in eggs were below the

LOQ of 0.01 mg/kg. No bifenthrin residues were found in any of the tissue samples of the 0.25 ppm dosing group (< 0.02 muscle, < 0.05 mg/kg liver, fat, gizzard). Biphenyl alcohol could only be detected in subcutaneous fat of the 0.25 ppm dosing group, but was always below LOQ of 0.05 mg/kg. It was not detected at the lower dosing level of 0.025 ppm. No TFP acid residues were found in any of the liver samples of the 0.25 ppm dosing group (< 0.05 mg/kg).

Animal commodity maximum residue level estimation

Cattle

The dietary burdens for the estimation of maximum residue levels for bifenthrin in animal commodities are 8.3 ppm for beef cattle and 7.41 ppm for dairy cattle. The dietary burdens for the estimation of STMR values are 3.35 ppm for beef cattle and 3.21 for dairy cattle.

In the table below, dietary burdens are shown in round brackets (), feeding levels and residue concentrations from the feeding study are shown in square brackets [] and estimated concentrations related to the dietary burdens are shown without brackets.

Dietary burden (ppm) Feeding level [ppm]	Milk	Milk fat	Muscle	Liver	Kidney	Fat
MRL	mean	highest	highest	highest	highest	highest
Beef cattle (8.26) [5/15]			0.104 mg/kg [< 0.1/0.24]	< 0.165 mg/kg [< 0.1/0.1]	0.108 mg/kg [0.1/0.19]	1.902 mg/kg [1.7/2.2]
Dairy cattle (7.41) [5/15]	0.088 mg/kg [0.082/0.15]	2.371 mg/kg [1.6/-]				
STMR	mean	mean	mean	mean	mean	mean
Beef cattle (3.4) [0/5]			< 0.068 mg/kg [< 0.1]	< 0.068 mg/kg [< 0.1]	< 0.068 mg/kg [< 0.1]	0.588 mg/kg [0.865]
Dairy cattle (3.21) [0/5]	0.053 mg/kg [0.082]	0.491 mg/kg [0.765]				

The data from the cattle feeding studies were used to support the estimation of maximum residue levels for bifenthrin in mammalian meat, edible offal and milk.

The Meeting estimated STMR values of 0.07 mg/kg for mammalian muscle and 0.59 mg/kg for mammalian fat, and a maximum residue level of 3 (fat) for mammalian meat. The HRs were 0.104 and 1.9 mg/kg for muscle and fat, respectively.

The Meeting estimated an STMR value of 0.07 mg/kg and a maximum residue level of 0.2 mg/kg for mammalian edible offal, based on liver and kidney data. The HR was 0.165 mg/kg.

The Meeting estimated an STMR value of 0.053 mg/kg and a maximum residue level of 0.2 mg/kg for milks.

The Meeting estimated an STMR value of 0.49 mg/kg and for milk fat. The Meeting estimated a maximum residue level of 3 mg/kg for milk fat.

Previous recommendations for cattle meat (fat) (0.5 mg/kg), cattle liver (0.05* mg/kg), cattle kidney (0.05* mg/kg), cattle fat (0.5 mg/kg) and cattle milk (0.05* mg/kg) were withdrawn.

Poultry

The dietary burdens for the estimation of maximum residue levels and STMR values for bifenthrin in poultry commodities are 1.79 ppm and 1.1 ppm, respectively.

An extrapolation from the highest dose level of 0.25 ppm in the laying hen feeding study to the estimated dietary burdens was not made because of the big distance.

The laying hen feeding study submitted is not adequate to estimate maximum residue levels, STMR and HR values for poultry tissues and eggs.

Previous recommendations for chicken eggs (0.01* mg/kg), chicken fat (0.05* mg/kg), chicken meat (fat) (0.05* mg/kg) and chicken, edible offal of (0.05* mg/kg) are withdrawn.

FURTHER WORK OR INFORMATION

The Meeting identified the following data gaps:

An adequate poultry feeding study at the dose level matching the animal dietary burden.

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 and IESTI assessment.

Definition of the residue (for compliance with the MRL and for estimation of dietary intake) for plant and animal commodities: *bifenthrin (sum of isomers).*

The residue is fat-soluble.

CCN	Commodity Name	MRL, mg/kg proposed	previous	STMR or STMR-P mg/kg	HR or HR-P mg/kg
FI 0327	Banana	0.1		0.01	0.01
GC 0640	Barley	W	0.05*		
AS 0640	Barley straw and fodder, dry	W	0.5		
FB 0264	Blackberries	1		0.29	0.51
VB 0040	Brassica (cole or cabbage) vegetables, Head cabbages, Flowerhead brassicas	0.3		0.115	0.19
MF 0812	Cattle fat	W [a]	0.5		
MO 1280	Cattle kidney	W [a]	0.05*		
MO 1281	Cattle liver	W [a]	0.05*		
MM 0812	Cattle meat	W [a]	0.5 (fat)		
ML 0812	Cattle milk	W [a]	0.05*		
PE 0840	Chicken eggs	W	0.01*		
PF 0840	Chicken fat	W	0.05*		
PM 0840	Chicken meat	W	0.05* (fat)		
PO 0840	Chicken, Edible offal of	W	0.05*		
FC 0001	Citrus fruits	0.05		0.05	0.05
SO 0691	Cotton seed	0.5		0.05	
	Cotton seed meal			0.003	
	Cotton seed oil, refined			0.005	
FB 0266	Dewberries (incl. Boysenberry and Loganberry)	1		0.29	0.51
MO 0105	Edible offal (Mammalian)	0.2		0.07	0.165
VO 0440	Egg plant	0.3		0.05	0.10
FC 0203	Grapefruit	W [b]	0.05*		
DH 1100	Hops, dry	20	10	1.9	
	Beer			0.011	
FC 0204	Lemon	W b	0.05*		
GC 0645	Maize	0.05*	0.05*	0	
AS 0645	Maize fodder	15	0.2	2.2 dry w	5.5 dry w
OC 0645	Maize oil, crude			0	
OR 0645	Maize oil, edible			0	
	Maize flour			0	
	Maize grits			0	
	Maize starch			0	
FI 0345	Mango	0.5 [c]		0.01	0.01

CCN	Commodity Name	MRL, mg/kg proposed	previous	STMR or STMR-P mg/kg	HR or HR-P mg/kg
MM 0095	Meat (from mammals other than marine mammals)	3 (fat)		0.59 (fat) 0.07 (muscle)	1.9 (fat) 0.104 (muscle)
FM 0183	Milk fats	3		0.49	
ML 0106	Milks	0.2		0.053	
VL 0485	Mustard greens	4		1.16	2.1
VO 0442	Okra	0.2 [c]		0.07	0.11
FC 0208	Orange, sweet	W [b]	0.05*		
FI 0350	Papaya	0.4 [c]		0.01	0.01
AL 0072	Pea hay or Pea fodder (dry)	0.7		0.093 dw	0.39 dw
FP 0230	Pear	W	0.5		
VO 0051	Peppers	0.5		0.14	0.31
HS 0444	Peppers chilli dried	5		1.4	
VR 0589	Potato	W [d]	0.05*		
VD 0070	Pulses	0.3		0.05	
VL 0494	Radish, leaves (including Radish tops)	4		1.75	2.3
SO 0495	Rape seed	0.05		0.05	
OR 0495	Rape seed oil, edible	0.1		0.08	
	Rape seed meal			0.027	
FB 0272	Raspberries, Red, Black	1		0.29	0.51
VR 0075	Root and tuber vegetables	0.05		0.05	0.05
	Soya bean meal			0.01	
	Soya bean oil, refined			0.05	
FB 0275	Strawberry [e]	3	1	0.46	2.3
DT 1114	Tea, Green, Black (black, fermented and dried)	30		5.2	
VO 0448	Tomato	0.3		0.06	0.15
	Tomato paste			0.04	
	Tomato puree			0.04	
TN 0085	Tree nuts	0.05		0.05	0.05
GC 0654	Wheat	0.5 Po	0.5 Po	0.25	0.40
CM 0654	Wheat bran, unprocessed	2 PoP	2 PoP	0.79 PoP	1.26 PoP
CF 1211	Wheat flour	W [f]	0.2 PoP		
CF 1210	Wheat germ	1 Po		0.45 PoP	0.72 PoP
AS 0654	Wheat straw and fodder, dry	W	0.5		
CF 1212	Wheat wholemeal	W [f]	0.5 PoP		

W: the recommendation is withdrawn

* : at or about the limit of quantification.

[a] The recommendations for cattle kidney and cattle liver are withdrawn, to be replaced by a recommendation for mammalian edible offal. Recommendations for cattle fat, meat and cattle milk are withdrawn and replaced by recommendations for mammalian meat and milks.

[b] The recommendations for grapefruit, lemon and orange, sweet are withdrawn to be replaced by recommendation for citrus fruits.

[c] The recommendations for mango, okra and papaya are based on reported use conditions provided appropriate protection of the crop, but were not supported by official information on uses.

[d] The recommendation for potato is withdrawn to be replaced by recommendation for root and tuber vegetables.

[e] For strawberry, the ARfD is exceeded. No alternative GAP is available.

[f] The recommendations for maximum residue levels for wheat flour and whole meal are withdrawn, because they are covered by the recommendation for wheat.

DIETARY RISK ASSESSMENT

Long-term intake

The International Estimated Dietary Intakes (IEDIs) of bifenthrin were calculated for the 13 GEMS/Food cluster diets using STMRs and STMR-Ps estimated by the current Meeting (see Annex 3 of the 2010 JMPR Report). The ADI is 0–0.01 mg/kg bw and the calculated IEDIs were 8–20% of the

maximum ADI. The Meeting concluded that the long-term intake of residues of bifenthrin resulting from the uses considered by the current JMPR is unlikely to present a public health concern.

Short-term intake

The International Estimated Short Term Intake (IESTI) for bifenthrin was calculated for food commodities and their processed fractions for which maximum residue levels were estimated and for which consumption data were available. The results are shown in Annex 4 of the 2010 JMPR Report.

For strawberries, the IESTI represented 230% of the ARfD of 0.01 mg/kg bw for the general population and 430% of the ARfD for children. The information provided to the JMPR precludes an estimate that the short-term intake of residue of bifenthrin from the consumption of strawberries will below the ARfD. The Meeting noticed that an alternative GAP for strawberries was not available.

For the other commodities considered by the JMPR, the IESTI represented 0–50% of the ARfD for the general population and 0–90% of the ARfD for children. The Meeting concluded that the short-term intake of residues of bifenthrin, when used in ways that have been considered by the JMPR (except strawberry), is unlikely to present a public health concern.

A concern form regarding the ARfD established by the JMPR in 2009 was received immediately prior to the current Meeting, long after the agreed CCPR deadline (see 3.1). The Meeting decided to defer this item to the next JMPR.

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