

**BIFENTHRIN (178)**

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**EXPLANATION**

Bifenthrin is a pyrethroid insecticide and miticide. It was first evaluated for residues and toxicology by the JMPR in 1992 and re-evaluated in 2009 (T), 2010 (R) and 2015 (R).

An ADI of 0–0.01 mg/kg bw and an ARfD of 0.01 mg/kg bw was established by the 2009 JMPR. The residue definition for compliance with MRLs and for estimation of dietary intake (for animal and plant commodities) is bifenthrin (sum of isomers). The residue is fat-soluble.

The 2015 JMPR evaluated additional uses on blueberries, grapes, head lettuce, spinach, celery, peas, snap beans and lima beans.

At the Fiftieth Session of the CCPR (2018), bifenthrin was scheduled for evaluation of additional uses. The current Meeting received new residues data and GAP information for mango, cucumber, okra and barley. In addition, new GAP information was provided for strawberry.

**METHODS OF RESIDUE ANALYSIS**

In the new data received by this Meeting several different methods were used to determine residues of bifenthrin in crops as outlined below:

***Andersson & Palsheden***

This method was used to determine residues in mango (trials conducted in Brazil).

Bifenthrin residues were extracted with ethyl acetate in the presence of Na<sub>2</sub>SO<sub>4</sub>. Sample clean up was achieved by gel permeation chromatography with elution using ethyl acetate: cyclohexane (1:1, v/v). The extract was concentrated and reconstituted with ethyl acetate: cyclohexane (1:1, v/v). Samples were diluted with cyclohexane with final determination achieved by GC-ECD.

Recovery data, generated during the course of each field phase, are summarized in Table 1. The method was linear over the range of 0.02–0.5 mg/kg.

***Method P-2132M***

This method was used to determine bifenthrin residues in cucumber and mango (trials conducted in the Philippines).

Samples were finely chopped and blended with acetone. The mixture was filtered and extracted again with acetone. The combined extract was concentrated under vacuum and hexane added. The sample was concentrated under vacuum again to about 10 mL. The extract was transferred to a separating funnel with hexane and aqueous NaCl solution and the mixture shaken. The organic layer was separated, and the aqueous layer re-extracted twice with hexane. The combined organic phase was concentrated under vacuum. Sample clean-up was undertaken on a Florisil column, eluting with 5% ethyl acetate in hexane. Final determination was achieved using GC-ECD. Procedural recovery data generated for the method are outlined in Table 1. The method was linear over the range of 0–50 ng injected.

***GC-MS/MS method***

This method was used to determine residues of bifenthrin in okra. Okra samples were homogenised with ethyl acetate and sodium sulphate. An aliquot of the ethyl acetate extract was shaken with Primary Secondary Amine (PSA) and centrifuged. The clear supernatant was filtered. Final determination was by GC-MS/MS. The ion monitored was m/z 181–166. Procedural recovery data

generated for the method are outlined in table 1. The method was linear over the range 0.005–0.25 µg/mL.

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This method was used to determine residues in barley grain and straw and is based on DFG S19 with extraction module E2, gel permeation chromatography (GPC), silica gel chromatography (module C1) and detection module D4 (GC-MSD).

Barley samples were mixed with warm water (40 °C) and then homogenised with acetone. The mixture was then homogenised with ethyl acetate: cyclohexane (1:1, v/v) and sodium chloride. An aliquot of the organic phase was filtered through sodium sulphate and concentrated. After the addition of ethyl acetate: cyclohexane (1:1, v/v), sodium sulphate and sodium chloride the mixture was shaken vigorously. Sample clean-up was achieved by gel permeation chromatography followed by silica gel chromatography. The eluant was concentrated and reconstituted in ethyl acetate. Final determination was by GC-MS. The ions monitored were m/z 166, 181 and 182. The method was linear over the range 0.05–2 µg/mL.

Validation data for this method for a range of crops, including wheat grain, were considered by the JMPR in 2010.

Table 1 Recovery data generated for methods used to determine bifenthrin

Crop/ Study reference	Analyte	Fortification level [mg/kg]	Individual recoveries [%]	Range of recoveries [%]	Mean recovery [%]	RSD
Cucumber P-2132M	Bifenthrin	0.1	80, 96.8, 97.6, 101, 101	80–101	95	9
Mango P-2132M	Bifenthrin	0.1	96	-	-	-
		1	92	-	-	-
Mango Andersson & Palsheden. Brazil 1999 trial	Bifenthrin	0.04	97, 101, 127	97–127	108	15
		0.5	87, 91, 96	87–96	91	4.9
Mango Andersson & Palsheden. Brazil 2003 trial	Bifenthrin	0.02	71, 73, 73, 78, 91	71–91	77	10
		0.2	73, 78, 80	73–80	77	4.7
Okra GC-MS	Bifenthrin	0.01	86.8, 89.1, 88.4	88.4–89.1	88.1	1.3
		0.02	90.2, 89.7, 88.2	88.2–90.2	89.3	1.2
		0.05	90.5, 88.1, 89.0	88.1–90.5	89.2	1.4

**Stability of residues in stored analytical samples**

The freezer storage stability of bifenthrin has been assessed previously by the JMPR.

In 2010 the JMPR concluded that bifenthrin residues were stable when stored at  $\leq -18$  °C for at least 18 months in oranges, 49 months in apples, 7 months in strawberries, 24 months in bananas, 36 months in lettuce, potato and pecans, 15 months in peas, dry, 34 months in maize grain and up to 24 months of storage in cotton seed.

In 2015 the JMPR evaluated data that demonstrated that bifenthrin residues were stable when stored at  $\leq -18$  °C for at least 176 days in grapes, 300 days in head lettuce, 561 days in celery, 210 days in peas with pods, 142 days in snap beans and up to 196 days in lima beans.

This Meeting received new storage stability data for head cabbage, cucumber, okra and barley grain and straw.

**Head cabbage, barley grain and straw**

A freezer storage stability study was conducted in head cabbage, barley grain and barley straw with the two enantiomers of bifenthrin (*cis*-Z-R,R-bifenthrin and *cis*-Z-S,S-bifenthrin).

Untreated samples were fortified with both *cis*-Z-R,R-bifenthrin and *cis*-Z-S,S-bifenthrin at 0.1 mg/kg.

Samples were then immediately stored at a temperature of  $\leq -18$  °C.

At time 0, one control sample and three fortified samples were analysed. Samples were removed for analysis after 1, 3, 6 and 12 months of frozen storage. At each time point one control sample and two fortified samples were analysed along with one freshly prepared fortified sample.

Residues of both enantiomers were determined using DFG S19. Validation data for the determination of bifenthrin in a range of matrices, including high water and high starch, were considered by the JMPR in 2010. The validated LOQ is 0.01 mg/kg.

Residues in the control samples were  $< 0.01$  mg/kg.

The results are summarized in Tables 2 and 3.

Table 2 Storage stability data for *cis*-Z-R,R-bifenthrin

Commodity	Storage period (months)	Residue level in freezer storage stability sample (mg/kg)	Average Percent remaining (%)	Procedural recovery for freshly fortified sample (%)
Head cabbage	0	0.087, 0.092, 0.089	100	-
	1	0.072, 0.084	87.3	78
	3	0.095, 0.105	112	101
	6	0.07, 0.081	84.5	86
	12	0.085, 0.092	99.1	90
Barley grain	0	0.077, 0.081, 0.087	100	-
	1	0.068, 0.071	85.1	80
	3	0.079, 0.072	92.4	85
	6	0.070, 0.059	79	84
	12	0.058, 0.058	71	72
Barley straw	0	0.086, 0.081, 0.089	100	-
	1	0.077, 0.084	94.3	76
	3	0.097, 0.080	104	87
	6	0.085, 0.069	90.2	94

**Bifenthrin**

Commodity	Storage period (months)	Residue level in freezer storage stability sample (mg/kg)	Average Percent remaining (%)	Procedural recovery for freshly fortified sample (%)
	12	0.079, 0.094	101	91

Table 3 Storage stability data for cis-Z-S,S-bifenthrin

Commodity	Storage period (months)	Residue level in freezer storage stability sample (mg/kg)	Average Percent remaining (%)	Procedural recovery for freshly fortified sample (%)
Head cabbage	0	0.088, 0.092, 0.089	100	-
	1	0.072, 0.084	87.0	84
	3	0.094, 0.098	107	93
	6	0.071, 0.082	85.3	89
	12	0.085, 0.092	98.7	90
Barley grain	0	0.078, 0.082, 0.087	100	-
	1	0.068, 0.071	84.5	79
	3	0.076, 0.073	90.5	87
	6	0.073, 0.060	80.8	85
	12	0.058, 0.058	70.4	72
Barley straw	0	0.086, 0.081, 0.089	100	-
	1	0.077, 0.083	93.8	75
	3	0.098, 0.081	105	86
	6	0.087, 0.069	91.4	95
	12	0.091, 0.080	100	91

**Cucumber**

Untreated samples were fortified with bifenthrin at 0.1024 mg/kg. Four samples were fortified and analysed for bifenthrin after 360–361 days of storage. Procedural recovery data and untreated control samples were not analysed. The results are summarized in Table 4.

Table 4 Storage stability data for bifenthrin in cucumber

Commodity	Storage period	Residue level in freezer storage stability sample (mg/kg)	Average Percent remaining (%)	Procedural recovery for freshly fortified sample (%)
Cucumber	0	No samples analysed		
	360–361	0.1104, 0.1059, 0.0817, 0.0931	Not possible to assess	No sample analysed

**Okra**

Untreated samples were fortified with bifenthrin at 0.1 mg/kg. Three samples were analysed at day 0 and three samples were analysed after 30 days of frozen storage at a temperature of  $\leq -18$  °C. At day 30 a freshly fortified sample, to serve as a procedural recovery sample, was not prepared for analysis.

Residues of bifenthrin were determined using the GC-MS/MS analytical method that was used in the residue trials provided for okra. The results are summarized in Table 5.

Table 5 Storage stability for bifenthrin in okra

Commodity	Storage period	Residue level in freezer storage stability sample (mg/kg)	Average percent remaining (%)	Procedural recovery for freshly fortified sample (%)
Okra	0	0.09, 0.091, 0.091	100	-
	30	0.09, 0.089, 0.09	99	No sample analysed

The maximum length of storage for which the samples were stored in the residue trials considered by this meeting is outlined in Table 6.

Table 6 Length of freezer storage for trials considered by the 2019 Meeting

Crop	Length of storage (days)
Mango	53
Cucumber	365
Okra	0
Barley grain	150
Barley straw	150

### USE PATTERN

Table 7 represents a summary of the additional GAPs submitted for consideration by the Meeting.

Table 7 Registered uses of bifenthrin submitted to the 2019 Meeting

Crop	Country	Indoor/ outdoor	Type	Timing of application	Rate (g ai/ha)	No. of appl (interval)	PHI (days)
Strawberry	USA	Outdoor	Foliar spray	See PHI	110	4 (7-10)†	3
Mango	Brazil	Outdoor	Foliar spray	See PHI	3 g ai/hL	1	7
	Philippines	Outdoor	Foliar spray	At early flowering to 12–14 days after flowering or 22–24 DAFI	4.5 g ai/hL	2 (not specified)	Approx.: 53-65
Cucumber	USA	Outdoor	Foliar or aerial spray	see PHI	110	3 (7)	3
Okra	India	Outdoor	Foliar spray	see PHI	1 <sup>st</sup> : 59 2 <sup>nd</sup> : 62	2 (not stated)	5
	USA	Outdoor	Foliar or aerial spray	See PHI	80	1-6  Total 220 g ai/ha	7
	USA	Outdoor	Foliar or aerial spray	See PHI	110	2 (7 days)	7
	USA	Outdoor	Soil application	-	90	1	No PHI specified

Crop	Country	Indoor/ outdoor	Type	Timing of application	Rate (g ai/ha)	No. of appl (interval)	PHI (days)
Cereals	Switzerland	Outdoor	Foliar spray	See PHI	16	2 (not specified)	42
Barley	Australia	Outdoor	Broadcast spray on the ground or aerial spray	Applied pre- emergence to soon after seedling emergence	20	1	No PHI specified  28 days WHP

† Two applications are applied with an interval of 7–10 days. 21 days must then pass and a further two applications with an interval of 7-10 days can be applied

DAFI days after flowering initiation

WHP withholding period for grazing or cutting for stock food

### RESULTS OF SUPERVISED RESIDUE TRIALS ON CROPS

#### Strawberry

No new residue trial data were received by the Meeting. The Meeting received information on a different GAP authorized in the USA with 4 applications of 0.11 kg ai/ha and a PHI of 3 days.

Residue trials evaluated by the 2010 JMPR are summarized in Table 8. Four trials, conducted in the USA, were conducted at  $4 \times 0.11$  kg ai/ha. A further eighteen trials, conducted in the USA, were conducted at an application rate of  $4 \times 0.22$  kg ai/ha.

The 2010 JMPR concluded that the analytical and storage stability aspects of the trials were adequately addressed and covered by the available data.

Table 8 Residue trial data on strawberry evaluated by the 2010 JMPR

Location, Country Year, Crop/Variety	Rate (kg ai/ha)	Interval (days)	Growth stage at last application	DALA (days)	Crop part	Bifenthrin residues (mg/kg)	Reference
GAP USA	MID: 0.11 MTD: 0.44	7–10	-	3	-	-	-
Watsonville, CA, USA 1984 Strawberry/ Heidi†	0.11 0.11 0.11 0.11	- 14 35 14	Not reported	0 1 2 3 5	Fruit	0.21, 0.22 (0.22) 0.27, 0.24 (0.26) 0.23, 0.24 (0.24) 0.20, 0.20 (0.20) 0.21, 0.20 (0.20)	JMPR 2010  †HR from replicate trials is 0.2 mg/kg
Watsonville, CA, USA 1984 Strawberry / Heidi †  (Replicate trial)	0.11 0.11 0.11 0.11	- 12 48 16	Not reported	0 1 3	Fruit	0.18, 0.17 (0.18) 0.14, 0.15 (0.14) 0.11, 0.15 (0.13)	

Location, Country Year, Crop/Variety	Rate (kg ai/ha)	Interval (days)	Growth stage at last application	DALA (days)	Crop part	Bifenthrin residues (mg/kg)	Reference
Oxnard, CA, USA 1983  Strawberry / H4	0.11	-	Not reported	0	Fruit	0.36, 0.32 (0.34)	
	0.11	14		1		0.31, 0.29 (0.30)	
	0.11	15		3		0.26, 0.26 (0.26)	
	0.11	13					
Watsonville, CA, USA 1983  Strawberry/ Heidi	0.11	-	Not reported	0	Fruit	0.35, 0.42 (0.39)	
	0.11	14		1		0.37, 0.29 (0.33)	
	0.11	30		3		0.33, 0.29 (0.31)	
	0.11	14					
Orange County, CA, USA 1984  Strawberry/ Tuft	0.22	-	Not reported	0	Fruit	<0.10, 0.48 (0.28)	
	0.22	13				0.23, 0.47 (0.35)	
	0.22	14		1		0.11, 0.46 (0.29)	
	0.22	14		3			
Evansville, IN, USA 1984  Strawberry / Variety not reported	0.22	-	Not reported	0	Fruit	0.19, 0.29 (0.24)	
	0.22	15		1		0.24, 0.17 (0.21)	
	0.22	14		3		0.24, 0.33 (0.29)	
	0.22	14					
Mechanicsburg, PA, USA 1984  Strawberry / Raritan	0.22	-	Not reported	0	Fruit	0.29, 0.16 (0.23)	
	0.22	27		1		0.33, 0.26 (0.30)	
	0.22	15		3		0.20, 0.12 (0.16)	
	0.22	19					
Cornelius, OR, USA 1984  Strawberry / Tatum	0.22	-	Not reported	0	Fruit	0.28, 0.30 (0.29)	
	0.22	14		1		0.35, 0.28 (0.32)	
	0.22	14		3		0.31, 0.41 (0.36)	
	0.22	25					
Watsonville, CA, USA 1984  Strawberry / Heidi	0.22	-	Not reported	0	Fruit	0.30, 0.34 (0.32)	
	0.22	16		1		0.24, 0.12 (0.18)	
	0.22	13		3		0.20, 0.23 (0.22)	
	0.22	13					

## Bifenthrin

Location, Country Year, Crop/Variety	Rate (kg ai/ha)	Interval (days)	Growth stage at last application	DALA (days)	Crop part	Bifenthrin residues (mg/kg)	Reference
Dover, FL, USA 1984  Strawberry / Dover	0.22	-	Not reported	0	Fruit	0.75, 0.88 (0.82)	
	0.22	13		1		0.56, 0.43 (0.50)	
	0.22	14		3		0.45, 0.42 (0.44)	
	0.22	14					
Phelps, NY, USA 1984  Strawberry / Ozark Beauty	0.22	-	Not reported	0	Fruit	0.46, 0.40 (0.43)	
	0.22	14		1		0.35, 0.30 (0.33)	
	0.22	14		3		0.22, 0.27 (0.25)	
	0.22	43					
Fennville, MI, USA 1984  Strawberry / Midway	0.22	-	Not reported	0	Fruit	0.31, 0.29 (0.30)	
	0.22	14		1		0.34, 0.32 (0.33)	
	0.22	21		3		0.27, 0.20 (0.24)	
	0.22	8					
Salinas, CA, USA 1987  Strawberry / Heidi	0.22	-	Not reported	0	Fruit	0.46, 0.86 (0.66)	
	0.22	7		1		0.29, 0.43 (0.36)	
	0.22	7		3		0.29, 0.31 (0.30)	
	0.22	8		5		0.14, 0.21 (0.18)	
Santa Maria, CA, USA 1987  Strawberry / Douglas	0.22	-	Not reported	0	Fruit	0.13, 0.054 (0.092)	
	0.22	14				0.077, 0.11 (0.094)	
	0.22	11		1		0.51, 0.44 (0.48)	
	0.22	10		3 5		0.16, 0.27 (0.22)	
Hammond, LA, USA 1988  Strawberry / Tangi	0.22	-	Not reported	0	Fruit	0.34, 0.34 (0.34)	
	0.22	7		1		0.29, 0.36 (0.33)	
	0.22	17		3		0.30, 0.29 (0.30)	
	0.22	4		5		0.30, 0.23 (0.27)	



Location, Country Year, Crop/Variety	Rate (kg ai/ha)	Interval (days)	Growth stage at last application	DALA (days)	Crop part	Bifenthrin residues (mg/kg)	Reference
Groveland, FL, USA 1988  Strawberry / Chandler	0.22	-	Not reported	0	Fruit	1.4, 2.3 (1.9)	
	0.22	8		1		0.86, 1.4 (1.1)	
	0.22	10		3		0.81, 0.92 (0.87)	
	0.22	7		5		0.56, 0.64 (0.60)	
Dover, FL, USA 1988  Strawberry / Dover	0.22	-	Not reported	0	Fruit	1.8, 1.0 (1.4)	
	0.22	7		1		1.5, 2.1 (1.8)	
	0.22	7		3		1.6, 1.7 (1.7)	
	0.22	7		5		1.1, 1.2 (1.2)	
Cornelius, Washington, OR, USA 1990  Strawberry / Benton	0.22	-	Not reported	0	Fruit	0.34, 0.46 (0.40)	
	0.22	8		1		0.34, 0.24 (0.29)	
	0.22	10		3		0.29, 0.30 (0.30)	
	0.22	8					
Phelps, Ontario, NY, USA 1990  Strawberry / Sunrise	0.22	-	Not reported	0	Fruit	0.26, 0.24 (0.25)	
	0.22	10		1		0.22, 0.23 (0.23)	
	0.22	13		3		0.31, 0.12 (0.22)	
	0.22	7					
Hammond, Tangipahoa, LA, USA 1991  Strawberry / Chandler	0.22	-	Not reported	0	Fruit	0.75, 0.86 (0.81)	
	0.22	7		1		0.76, 0.75 (0.76)	
	0.22	7		3		0.65, 0.58 (0.62)	
	0.22	7					
Santa Maria, Santa Barbara, CA, USA 1990  Strawberry / Selva §	0.22	-	Not reported	0	Fruit	0.15, 0.27 (0.21)	§HR from replicate trials is 0.19 mg/kg
	0.22	16		1		0.13, 0.14 (0.14)	
	0.22	13		3		0.22, 0.16 (0.19)	
	0.22	6					
Santa Maria, Santa Barbara, CA, USA 1990  Strawberry / Selva §	0.22	-	Not reported	0	Fruit	0.24, 0.30 (0.27)	
	0.22	16		1		0.26, 0.09 (0.18)	
	0.22	13		3		0.07, 0.15 (0.11)	
	0.22	13					

Value in bracket is mean of duplicate field samples

MID: Maximum individual dose

MTD: Maximum total dose

† Trials conducted at same site and at the same time. Therefore, the trials are not regarded as independent trials. HR is 0.2 mg/kg from replicate trials

§Trials conducted at same site and at the same time. Therefore, the trials are not regarded as independent trials. HR is 0.19 mg/kg

### Mango

The JMPR received new trial data coupled with data submitted previously to the 2010 JMPR.

Residue trials evaluated by the 2010 JMPR are summarized in Table 9. Four trials were conducted in Mali and Senegal at a rate of  $2 \times 0.05$  kg ai/ha. The 2010 JMPR evaluation states the trials were conducted with 1 application however the trial reports confirm that 2 applications were made. The 2010 JMPR concluded that the analytical and storage stability aspects of the trials were adequately addressed and covered by the available data.

Table 9 Residue trial data for mango evaluated by the 2010 JMPR

Location, Country, Year, Crop/Variety	Rate (kg ai/ha)	Rate (kg ai/hL)	Interval between applications (days)	Growth stage at last application	DALA (days)	Crop part	Bifenthrin residues (mg/kg)	Reference
GAP Brazil	MID: 0.015–0.03 MTD: 0.015–0.03	MID: 0.003 MTD: 0.003	N/A	-	7	-	-	-
Senegal, 2004  Mango/ Keitt	0.05 0.05	0.0125 0.0125	- 10	11 days before maturity	1 4 7 7 7 14 14 14 21	Whole fruit <sup>1</sup> Whole fruit <sup>1</sup> Whole fruit <sup>1</sup> Flesh Peel Whole fruit <sup>1</sup> Flesh Peel Whole fruit <sup>1</sup>	0.31 0.12 0.13 <0.01 1.38 0.07 <0.01 1.94 0.13	SE/CERES/MA/2004/1 Analysis PIP-051
Baguinida, Mali, 2005  Mango/Kent	0.05 0.05	0.009 0.009	- 10	Not reported	1 4 7 7 7 14 14 14 21	Whole fruit <sup>1</sup> Whole fruit <sup>1</sup> Whole fruit <sup>1</sup> Flesh Peel Whole fruit <sup>1</sup> Flesh Peel Whole fruit <sup>1</sup>	0.13 0.15 0.14 <0.01 0.49 0.04 <0.01 0.20 0.04	MLI/IER/MA/2004/2 Analysis A4168-1

Location, Country, Year, Crop/Variety	Rate (kg ai/ha)	Rate (kg ai/hL)	Interval between applications (days)	Growth stage at last application	DALA (days)	Crop part	Bifenthrin residues (mg/kg)	Reference
Silasso, Mali, 2005  Mango/Kent	0.05 0.05	0.0125 0.0125	- 10	Not reported	1	Whole fruit <sup>1</sup>	0.07	MLI/IER/MA/2004/2 Analysis A4168-1
					4	Whole fruit <sup>1</sup>	0.06	
					7	Whole fruit <sup>1</sup>	0.06	
					7	Flesh	<0.01	
					7	Peel	0.34	
					14	Whole fruit <sup>1</sup>	0.03	
					14	Flesh	<0.01	
					14	Peel	0.20	
Kati, Mali, 2004,  Mango/Haden	0.05 0.05	0.0125 0.0125	- 10	Not reported	1	Whole fruit <sup>1</sup>	0.053	MLI/IER/MA/2004/2 Analysis A4168-1
					4	Whole fruit <sup>1</sup>	0.077	
					7	Whole fruit <sup>1</sup>	0.234	
					7	Flesh	<0.01	
					7	Peel	0.521	
					14	Whole fruit <sup>1</sup>	0.179	
					14	Flesh	<0.01	
					14	Peel	0.895	
21	Whole fruit <sup>1</sup>	0.011						

<sup>1</sup> Calculated residue in whole fruit including the stone

Three new trials conducted in Brazil have been provided. At each trial site two different application regimes were investigated. One application ranging from 0.06–0.036 kg ai/ha was made.

Samples were immediately frozen and maintained in frozen storage for periods of up to 46 days prior to extraction and analysis.

Residues of bifenthrin were determined using analytical method ‘Anderson and Palsheden’. Recovery data were generated during the analysis and acceptable recoveries were obtained.

A summary of the residue trials is provided in Table 10.

Table 10 Supervised residue trials on mango conducted in Brazil

Location, Country, Year, Crop/Variety	Rate (kg ai/ha)	Water volume (L/ha)	Rate (kg ai/hL)	Growth stage at last application	DALA (days)	Crop part	Bifenthrin residues (mg/kg)	Reference
GAP Brazil	GAP based on spray conc	500–1000	MID: 0.003 MTD: 0.003	-	7	-	-	-
Ilha Solteira, SP, Brazil 1999	0.06	2000	0.003	Maturation of fruits	0	Mature fruit	<0.04	BR 205  2864/00
					7		<0.04	
					15		<0.04	
Mango/Haden	0.12	2000	0.006	Maturation of fruits	0	Mature fruit	0.1	
					7		0.08	
					15		<0.04	

Location, Country Year, Crop/Variety	Rate (kg ai/ha)	Water volume (L/ha)	Rate (kg ai/hL)	Growth stage at last application	DALA (days)	Crop part	Bifenthrin residues (mg/kg)	Reference
Area 2 Janauba, MG, Brazil 2003 Mango/ Tommy Atkins	0.018	600	0.003	Maturation of fruits	0 7 15	Mature fruit	<0.02 <0.02 <0.02	BR224  MAN-TAL 100CE-R-03
	0.036	600	0.006	Maturation of fruits	0 7 15	Mature fruit	<0.02 <0.02 <0.02	
Area 3 Juazeiro, BA, Brazil 2003 Mango/ Tommy Atkins	0.018	600	0.003	Maturation of fruits	0 7 15	Mature fruit	<0.02 <0.02 <0.02	BR225  MAN-TAL 100CE-R-03
	0.036	600	0.006	Maturation of fruits	0 7 15	Mature fruit	<0.02 <0.02 <0.02	

MID Maximum individual dose

MTD maximum total dose

One trial was conducted in the Philippines. The trial was conducted with 5 applications of 0.003 or 0.004 kg ai/hL. The spray volume used was 60–80 L for 12 trees. The number of trees per hectare and the plot sizes are not reported. The sampling dates for analysis are not given. A detailed field phase report was not provided.

Samples were frozen immediately on collection and stored at  $\leq -18$  °C for up to 53 days prior to extraction and analysis.

Bifenthrin residues were determined using method P-2132M. Procedural recoveries were conducted at a fortification level of 0.1 mg/kg and 1 mg/kg with acceptable recoveries of 92–96% being obtained.

A summary of the residue trials is shown in Table 11.

Table 11 Supervised residue trials on mango conducted in the Philippines

Location, Country Year, Crop/Variety	Rate (kg ai/hL)	Interval (days)	Growth stage at last application	DALA (days)	Crop part	Bifenthrin residues (mg/kg)	Reference
GAP Philippines	2 × 0.0045	N/A	22- 24 DAFI		-	-	-
Nueva Ecija, Philippines, 2013 Mango/ Carabao	0.003 0.003 0.003 0.003 0.003		65–67 DAFI	Not stated†	Fruits	<0.1	

Location, Country Year, Crop/Variety	Rate (kg ai/hL)	Interval (days)	Growth stage at last application	DALA (days)	Crop part	Bifenthrin residues (mg/kg)	Reference
	0.004 0.004 0.004 0.004 0.004		65-67 DAFI	Note stated†	Fruits	<0.1	

DAFI Days after flowering initiation

† The sponsor has stated that as the application was made 65-67 DAFI then the crops would have likely been sampled around 53- 65 days after the last treatment.

### Cucumber

Nine residue trials were conducted in the USA in 1990.

Three applications were made at an application rate of 0.11 kg ai/ha. Samples were frozen immediately on collection and stored for up to 12 months prior to extraction and analysis.

Samples were analysed using method P-2132M. Procedural recoveries were conducted at a fortification level of 0.1 mg/kg. Acceptable recoveries in the range of 70-110% were obtained.

The results are summarized in Table 12.

Table 12 residue trial data on cucumber conducted in the USA

Location, Country Year, Crop/Variety	Rate (kg ai/ha)	Interval (days)	Growth stage at last application	DALA (days)	Crop part	Bifenthrin residues (mg/kg)	Reference
GAP USA	MID: 0.11 MTD: 0.33	7	-	3	-	-	-
North Carolina, USA, 1990  Cucumber/ Calypso	0.11 0.11 0.11	- 35 10	-	0 3 7  0 3 7	Fruit  Peel   Pulp	<0.10, <0.10 (<0.10) <0.10, <0.10 (<0.10) <0.10, <0.10 (<0.10)  0.52, 0.54 (0.53) 0.13, 0.13 (0.13) 0.12, 0.11 (0.12)  <0.10, <0.10 (<0.10) <0.10, <0.10 (<0.10) <0.10, <0.10 (<0.10)	IR-4 PR No.4150  Trial 01
Eagle, Michigan, USA, 1990  Cucumber/ Dasher II F1†	0.11 0.11 0.11	- 13 7	-	3 7	Fruit	<0.10, <0.10 (<0.10) <0.10, <0.10 (<0.10)	IR-4 PR No.4150  Trial 02

## Bifenthrin

Location, Country Year, Crop/Variety	Rate (kg ai/ha)	Interval (days)	Growth stage at last application	DALA (days)	Crop part	Bifenthrin residues (mg/kg)	Reference
Eagle, Michigan, USA, 1990	0.11 0.11 0.11	- 13 7	-	0 3 7	Fruit	0.11, <0.10 (0.11) <0.10, <0.10 (<0.10) <0.10, <0.10 (<0.10)	IR-4 PR No. 4150
Cucumber/ Dasher II F1†				0 3 7	Peel	0.42, 0.27 (0.35) 0.33, 0.59 (0.46) 0.28, 0.26 (0.27)	Trial 03  †Trials are replicates. HR = 0.10 mg/kg
				0 3 7	Pulp	<0.10, <0.10 (<0.10) <0.10, <0.10 (<0.10) <0.10, <0.10 (<0.10)	
Frio County, Texas, USA, 1990	0.11 0.11 0.11	- 31 7	-	3 7	Fruit	<0.10, <0.10 (<0.10) <0.10, <0.10 (<0.10)	IR-4 PR No. 4150  Trial 04
Cucumber/variety not stated							
Tipp City, Ohio, USA, 1990	0.11 0.11 0.11	- 9 9	-	3 7	Fruit	<0.10, <0.10 (<0.10) <0.10, <0.10 (<0.10)	IR-4 PR No. 4150  Trial 05
Cucumber/ National Pickling							
Zellwood, Florida, USA, 1990	0.11 0.11 0.11	- 18 7	-	3 7	Fruit	<0.10, <0.10 (<0.10) <0.10, <0.10 (<0.10)	IR-4 PR No. 4150 Trial 06
Cucumber/ Calypso							
Yuma, Arizona, USA, 1990	0.11 0.11 0.11	- 41 7		3 7	Fruit	<0.10, <0.10 (<0.10) <0.10, <0.10 (<0.10)	IR-4 PR No. 4150  Trial 07
Cucumber/ Dasher II)§							
Yuma, Arizona, USA, 1990	0.11 0.11 0.11	- 41 7		3 7	Fruit	0.24, <0.10 (0.17) <0.10, <0.10 (<0.10)	IR-4 PR No. 4150  Trial 08 §Trials are replicates. HR = 0.17 mg/kg
Cucumber/ Dasher II)§							
Centerton, New Jersey, USA, 1990	0.11 0.11 0.11	- 17 11		3 7	Fruit	0.21, 0.19 (0.20) 0.16, <0.10 (0.13)	IR-4 PR No. 4150  Trial 09
Cucumber/ Asgrow 76							

Value in bracket is mean of duplicate field samples

MID Maximum individual dose

MTD Maximum total dose

*Okra*

The sponsor has referenced residues data previously evaluated by the JMPR and has provided new residue trial data.

In residues data on okra previously considered by the 2010 JMPR, four trials were conducted at an application rate of  $2 \times 0.04$  kg ai/ha with samples collected 2 and 7 days after the last application. The trials are summarized in Table 13.

Table 13 Residue trial data on okra evaluated by the 2010 JMPR

Location, Country Year, Crop/Variety	Rate (kg ai/ha)	DALA (days)	Crop part	Bifenthrin residues (mg/kg)	Reference
GAP USA	MID: 0.11 MTD: 0.22	7	-	-	-
Abengourou, Cote d'Ivoire 2004, dry season	0.04 0.04	2 7	Fruit	0.04 0.02	CI/AIPR/2004/03 Analysis PIP No. 0160/22
Abengourou, Cote d'Ivoire 2004, rainy season	0.04 0.04	2 7	Fruit	0.05 <0.01	
Dabou, Cote d'Ivoire  2004	0.04 0.04	2 7	Fruit	0.11 0.04	
Dabou, Cote d'Ivoire  2004, dry season	0.04 0.04	2 7	Fruit	0.09 0.01	

MID: Maximum individual dose

MTD: Maximum total dose

The Meeting received new residue data on okra conducted in India. In four trials on okra two applications at either 0.0575 kg ai/ha or 0.1150 kg ai/ha were made at each site.

Samples were analysed immediately after collection.

Residue of bifenthrin were determined in okra using the GC-MS method outlined above.

Table 14 Residue trial data on okra conducted in India

Location, Country Year, Crop/Variety	Rate (kg ai/ha)	Interval (days)	Growth stage at last application	DALA (days)	Crop part	Bifenthrin residues (mg/kg)	Reference
GAP India	MID: 0.059- 0.062  MTD: 0.118- 0.124	-	-	5	-	-	-

## Bifenthrin

Location, Country Year, Crop/Variety	Rate (kg ai/ha)	Interval (days)	Growth stage at last application	DALA (days)	Crop part	Bifenthrin residues (mg/kg)	Reference
Pantnagar, India 2014  Okra/variety not reported	0.0575 0.0575			0	Fruit	0.289, 0.319, 0.328, (0.312)	
				1		0.092, 0.108, 0.106 (0.102)	
				3		0.036, 0.035, 0.029 (0.033)	
				5		0.022, 0.014, 0.019 (0.018)	
	0.1150 0.1150			0	Fruit	0.395, 0.386, 0.414 (0.398)	
				1		0.183, 0.195, 0.187 (0.188)	
				3		0.092, 0.083, 0.082 (0.086)	
				5		0.026, 0.019, 0.022 (0.022)	
Bhubaneswar, India, 2015  Okra/variety not reported	0.0575 0.0575			0	Fruit	0.189, 0.194, 0.195(0.193)	
				1		0.129, 0.126, 0.110 (0.122)	
				3		0.024, 0.021, 0.023 (0.023)	
				5		<0.01, <0.01, <0.01 (<0.01)	
	0.0575 0.0575			7	Fruit	<0.01, <0.01, <0.01 (<0.01)	
				0		0.189, 0.194, 0.195(0.193)	
				1		0.129, 0.126, 0.110 (0.122)	
				3		0.024, 0.021, 0.023 (0.023)	
0.0575 0.0575			5	Fruit	<0.01, <0.01, <0.01 (<0.01)		
			7		<0.01, <0.01, <0.01 (<0.01)		
			0		0.189, 0.194, 0.195(0.193)		
			1		0.129, 0.126, 0.110 (0.122)		
0.0575 0.0575			3	Fruit	0.024, 0.021, 0.023 (0.023)		
			5		<0.01, <0.01, <0.01 (<0.01)		
			7		<0.01, <0.01, <0.01 (<0.01)		
			0		0.189, 0.194, 0.195(0.193)		



Location, Country Year, Crop/Variety	Rate (kg ai/ha)	Interval (days)	Growth stage at last application	DALA (days)	Crop part	Bifenthrin residues (mg/kg)	Reference
	0.1150 0.1150			0 1 3 5 7	Fruit	0.370, 0.359, 0.420 (0.383)  0.222, 0.217, 0.249 (0.229)  0.043, 0.045, 0.046 (0.045)  <0.01, <0.01, <0.01 (<0.01)  <0.01, <0.01, <0.01 (<0.01)	
Hiriyur/ India, 2015  Okra/variety not reported	0.0575 0.0575			0 1 3 5 7	Fruit	0.265, 0.279, 0.250 (0.264)  0.120, 0.120, 0.119 (0.121)  0.056, 0.051, 0.050 (0.052)  0.015, 0.013, 0.015 ( <u>0.014</u> )  <0.01, <0.01, <0.01 (<0.01)	Location 1 Pantnagar
	0.1150 0.1150			0 1 3 5 7	Fruit	0.690, 0.686, 0.645 (0.674)  0.495, 0.510, 0.520 (0.508)  0.145, 0.090, 0.135 (0.123)  0.014, 0.016, 0.018 (0.016)  <0.01, <0.01, <0.01 (<0.01)	Location 2 Bhubaneswar

**Bifenthrin**

Location, Country Year, Crop/Variety	Rate (kg ai/ha)	Interval (days)	Growth stage at last application	DALA (days)	Crop part	Bifenthrin residues (mg/kg)	Reference
Varanasi, India, 2015  Okra/variety not stated	0.0575 0.0575			0	Fruit	0.250, 0.270, 0.238 (0.253)	Location 3 Hiriyur
				1		0.149, 0.152, 0.170 (0.157)	
				3		0.01, 0.015, 0.010 (0.012)	
				5		<0.01, <0.01, <0.01 ( <u>&lt;0.01</u> )	
				7		<0.01, <0.01, <0.01 (<0.01)	
	0.1150 0.1150			0	Fruit	0.509, 0.501, 0.542 (0.517)	Location 4 Varanasi
				1		0.321, 0.292, 0.313 (0.309)	
				3		0.040, 0.031, 0.030 (0.034)	
				5		<0.01, <0.01, <0.01 (<0.01)	
				7		<0.01, <0.01, <0.01 (<0.01)	

Values in bracket are means of duplicate field samples

MID Maximum individual dose

MTD maximum total dose

**Barley**

The sponsor has referenced residue trials previously evaluated by the JMPR and has submitted new trial data.

Residue trials were evaluated by the 2010 JMPR are summarized in Table 15. The trials were conducted with two applications at a rate of approximately 0.01 kg ai/ha.

The 2010 JMPR concluded that the analytical and storage stability aspects of the trials were adequately addressed and covered by the available data.

Table 15 Residues data on barley evaluated by the 2010 JMPR

Location, Country Year, Crop/Variety	Rate (kg ai/ha)	Interval (days)	Growth stage at last application	DALA (days)	Crop part	Bifenthrin residues (mg/kg)	Reference
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Location, Country Year, Crop/Variety	Rate (kg ai/ha)	Interval (days)	Growth stage at last application	DALA (days)	Crop part	Bifenthrin residues (mg/kg)	Reference
GAP Switzerland	MID: 0.016 MTD: 0.032		-	42	-	-	-
Kluczewo, Poland, 2007  Barley/Kroton	0.0104 0.0103	- 13	BBCH 69	35	Grain	0.03	20074083/E1- FPWB
Otorowo, Poland, 2007  Barley/ Lomerit	0.0108 0.0107	- 15	BBCH 77	34	Grain	0.02	
Melissihori, Greece, 2007  Barley/Arta	0.0103 0.0103	- 14	BBCH 71-73	35	Grain	0.01	
Akropotomia, Greece, 2007  Barley/Arta	0.0097 0.0104	- 13	BBCH 73	35	Grain	0.01	
Conselice, Italy, 2007  Barley/ Sonoro	0.01 0.01	- 16	BBCH 79	29	Grain	0.04	
Grandola, Italy, 2007  Barly/ Siberia	0.0105 0.0095	- 14	BBCH 73	31	Grain	0.07	
Montauban, France, 2007  Barley/ Aurelie	0.01 0.0099	- 14	BBCH 71	33	Grain	0.02	
Montermier, France, 2007  Barley/ Duchess	0.01 0.01	- 13	BBCH 71 -72	37 37	Grain	0.02	
Riedback, Germany, 2002  Barley/ Henni	0.0075 0.0075	- 13	BBCH 75	35 41	Grain Grain	<0.01 <0.01	
Blumnhagen, Germany, 2002  Barley/ Barke	0.0075 0.0075	- 14	BBCH 79	36 41	Grain Grain	<0.01 <0.01	
Kottmansweiler, Germany, 2001  Barley/Regina	0.0075 0.0075	- 14	BBCH 73	35 41	Grain Grain	0.02 0.02	20011318/01- RWB

Location, Country Year, Crop/Variety	Rate (kg ai/ha)	Interval (days)	Growth stage at last application	DALA (days)	Crop part	Bifenthrin residues (mg/kg)	Reference
Weidmsdorf, Germany, 2001  Barley/ Carola	0.0075	-	BBCH 79	35	Grain	<0.01	
	0.0075	12		43	Grain	<0.01	
Baden- Wurtemberg, Germany, 2001  Barley/ Duett	0.0076	-	BBCH 77-83	35	Grain	0.01	20011318/02- RWB
	0.0075	16		42	Grain	0.01	
Ebershein, France†, 2002  Barley/ Platine	0.0076	-	BBCH 62	42	Grain	0.02	20021228/E1- FPCE
	0.0079	14					

MID Maximum individual dose

MTD maximum total dose

†Reported in the 2010 JMPR evaluation as being conducted in Germany. The trial was conducted in France.

The Meeting received new residue trials data conducted on barley in 2009 in the EU. The trials were conducted with two applications at a rate of 0.009–0.011 kg ai/ha.

Samples were immediately frozen and maintained in frozen storage for periods of up to 5 months prior to extraction and analysis.

Samples were analysed for bifenthrin residues using method L 00.00-34. Procedural recoveries were conducted at fortification levels of 0.01–0.1 mg/kg and gave acceptable recoveries. The method has an LOQ of 0.01 mg/kg.

A summary of the residue trial data is provided in Table 16.

Table 16 Residue trial data on barley conducted in 2009

Location, Country Year, Crop/Variety	Rate (kg ai/ha)	Interval (days)	Growth stage at last application	DALA (days)	Crop part	Bifenthrin residues (mg/kg)	Reference
GAP Switzerland	MID: 0.016 MTD: 0.032		-	42	-	-	-
Ploeren, France, 2009  Barley/ Platine	0.011	-	BBCH 83	36	Grain	0.04	S09-00395
	0.01	14					
Burweg, Germany, 2009  Barley/ Naomie	0.01 0.011	- 13	BBCH 75	34	Grain	<0.01	
Pazmand, Hungary, 2009  Barley/ Nelly	0.01 0.011	- 14	BBCH 65	38	Grain	0.03	

Location, Country Year, Crop/Variety	Rate (kg ai/ha)	Interval (days)	Growth stage at last application	DALA (days)	Crop part	Bifenthrin residues (mg/kg)	Reference
Osowo, Poland, 2009  Barley/ Lomerit	0.01 0.011	- 14	BBCH 73	35	Grain	0.02	
Nottinghamshire, UK, 2009  Barley/ Pearl	0.01 0.011	- 13	BBCH 65-70	43	Grain	0.02	
Leicestershire, UK, 2009  Barley/ Carat	0.011 0.011	- 14	BBCH 61-62	38	Grain	0.03	
Montauban, France, 2009  Barley/ Azurel	0.01 0.01	- 14	BBCH 65	35	Grain	0.02	
Villarreal, Spain, 2009  Barley/ Tipper	0.009 0.01	- 12	BBCH 73-75	34	Grain	0.02	

MID Maximum individual dose

MTD maximum total dose

### Oats

Residue trials on oats evaluated by the 2010 JMPR are summarized in Table 17. The trials were conducted with two applications at a rate of approximately 0.007–0.008 kg ai/ha.

The 2010 JMPR concluded that the analytical and storage stability aspects of the trials were adequately addressed and covered by the available data.

Table 17 Residue data on oat grain evaluated by the 2010 JMPR

Country, year, location	Application			PHI, days	Bifenthrin residues mg/kg	Report
	Form	kg ai/ha	No			
France, 2002	SC	0.008	2	41	<0.01	20021228/E1/FPCE
UK, 2002	SC	0.007-0.008	2	41	<0.01	20021228/E1/FPCE

### Triticale

Residue trials on triticale evaluated by the 2010 JMPR are summarized in Table 18. The trials were conducted with two applications at a rate of approximately 0.007–0.008 kg ai/ha.

The 2010 JMPR concluded that the analytical and storage stability aspects of the trials were adequately addressed and covered by the available data.

Table 18 Residue data on triticale grain evaluated by the 2010 JMPR

Country, year, location	Application			PHI, days	Bifenthrin residues, mg/kg	Report
	Form	Kg ai/ha	No			

Germany, 2001	SC	0.008	2	34 43	<0.01 <0.01	20011318/01-RTR
UK, 2002	SC	0.007	2	43	<0.01	20021228/E1/FPCE

### Wheat

Residue trials on wheat evaluated by the 2010 JMPR are summarized in Table 19. The trials were conducted with two applications at rates of approximately 0.003–0.01 kg ai/ha.

The 2010 JMPR concluded that the analytical and storage stability aspects of the trials were adequately addressed and covered by the available data.

Table 19 Residue data on wheat grain evaluated by the 2010 JMPR

Country, year, location	Application			PHI, days	Bifenthrin residues, mg/kg	Report
	Form	kg ai/ha	No			
France, 2003, Versailles	SC	0.008	2	27	<0.01	20031328/01-RCE
France, 2003, Saint Laurent	SC	0.008	2	28	<0.01	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	20074083/E1-FPWW
France, 2009, Romanswiller	SC	0.01	2	35	<0.01	S09-00398
France, 2009, Rouvres-St.-Jean	SC	0.01	2	35	<0.01	S09-00398
Germany, 2001, Riedbach	SC	0.0075	2	35 41	<0.01 <0.01	20011318/02-RWW
Germany, 2001, Kottmansweiler	SC	0.0075	2	35 41	<0.01 <0.01	20011318/01-RWW
Germany, 2001, Lutter	SC	0.0075	2	35 41	<0.01 <0.01	20011318/01-RWW
Germany, 2002, Riedback	SC	0.0077	2	35 42	<0.01 <0.01	20011318/01-RWW
Germany, 2002, Jahnsdorf	SC	0.0978	2	35 42	<0.01 <0.01	20011318/01-RSWH
Germany, 2009	SC	0.01	2	35	<0.01	509-00398
Greece, 2007, Kilkis, Variety Mesapia	SC	0.01	2	34	<0.01	20074083/E1-EPWW
Greece, 2007, Kilkis, Variety Bronde	SC	0.01	2	34	<0.01	20074083/E1-EPWW
Hungary, 2007	SC	0.01	2	33	<0.01	20074083/E1-EPWW
Italy, 2007, Concelice	SC	0.01	2	35	<0.01	20074083/E1-EPWW
Italy, 2007, Budrio	SC	0.01	2	30	0.02	20074083/E1-EPWW

Country, year, location	Application			PHI, days	Bifenthrin residues, mg/kg	Report
	Form	kg ai/ha	No			
Italy, 2009	SC	0.01	2	35	<0.01	S09-01173
Poland, 2007	SC	0.01	2	35	<0.01	20074083/E1-EPWW
Spain, 2009	SC	0.01	2	35	<0.01	SOP-01173
UK, 1984 Upton Magna	EC	0.005	2	199	<0.02	FCC 66/4
UK, 1984 Bromyard	EC	0.005	2	199	<0.02	FCC 66/4
UK, 1984 Brighton	EC	0.005	2	158	0.02	FCC 66/4
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	73/48 IV
UK, 1985 Essex Variety Galahad	EC	0.006	2	189	<0.05, 0.05	73/48 IV
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	S09-00398
UK, 2009 North Cave Variety Oakley	SC	0.01	2	35	<0.01	S09-00398

### **Animal feeds**

#### **Barley straw**

Residue trials evaluated by the 2010 JMPR are summarized in Table 20. The trials were conducted with two applications at rates of approximately 0.01 kg ai/ha.

The 2010 JMPR concluded that the analytical and storage stability aspects of the trials were adequately addressed and covered by the available data.

Table 20 Residue data on barley evaluated by the 2010 JMPR

Location, Country Year, Crop/Variety	Rate (kg ai/ha)	Interval (days)	Growth stage at last application	DALA (days)	Crop part	Bifenthrin residues (mg/kg)	Reference
GAP USA	MID: 0.016 MTD: 0.032		-	42	-	-	-

## Bifenthrin

Location, Country Year, Crop/Variety	Rate (kg ai/ha)	Interval (days)	Growth stage at last application	DALA (days)	Crop part	Bifenthrin residues (mg/kg)	Reference
Kluczewo, Poland, 2007  Barley/Kroton	0.0104	-	BBCH 69	35	Straw	0.24	20074083/E1- FPWB
	0.0103	13					
Otorowo, Poland, 2007  Barley/ Lomerit	0.0108	-	BBCH 77	34	Straw	0.17	
	0.0107	15					
Melissihori, Greece, 2007  Barley/Arta	0.0103	-	BBCH 71-73	35	Straw	0.21	
	0.0103	14					
Akropotomia, Greece, 2007  Barley/Arta	0.0097	-	BBCH 73	35	Straw	0.11	
	0.0104	13					
Conselice, Italy, 2007  Barley/ Sonoro	0.01	-	BBCH 79	29	Straw	0.47	
	0.01	16					
Grandola, Italy, 2007  Barly/ Siberia	0.0105	-	BBCH 73	31	Straw	0.27	
	0.0095	14					
Montauban, France, 2007  Barley/ Aurelie	0.01	-	BBCH 71	33	straw	0.09	
	0.0099	14					
Montermier, France, 2007  Barley/ Duchess	0.01	-	BBCH 71 -72	37	Straw	0.23	
	0.01	13					
Riedback, Germany, 2002  Barley/ Henni	0.0075 0.0075	- 13	BBCH 75	-0	Whole plant	0.04	
				0	Whole plant	0.14	
				7	Whole plant	0.08	
				15	Whole plant	0.07	
				29	Whole plant	0.16	
				29	Ear	0.03	
				35	Straw	0.20	
				41	Straw	0.12	
Blumnhagen, Germany, 2002  Barley/ Barke	0.0075 0.0075	- 14	BBCH 79	-0	Whole plant	0.03	
				0	Whole plant	0.13	
				6	Whole plant	0.04	
				13	Whole plant	0.06	
				27	Whole plant	0.06	
				27	Ear	0.05	
				36	Straw	0.10	
				41	Straw	0.11	



Location, Country Year, Crop/Variety	Rate (kg ai/ha)	Interval (days)	Growth stage at last application	DALA (days)	Crop part	Bifenthrin residues (mg/kg)	Reference
Kottmansweiler, Germany, 2001  Barley/Regina	0.0075 0.0075	- 14	BBCH 73	-0	Whole plant	0.03	
				0	Whole plant	0.11	
				8	Whole plant	0.06	
				15	Whole plant	0.07	
				28	Whole plant	0.16	
				2 8	Ear	0.08	
				35	Straw	0.20	
				41	Straw	0.18	
Kottmansweiler, Germany, 2001  Barley/ Carola	0.0075 0.0075	- 12	BBCH 79	35	Straw	0.11	
				43	Straw	0.09	
Baden- Wurtemberg, Germany, 2001  Barley/ Duett	0.0076 0.0075	- 16	BBCH 77-83	-0	Whole plant	0.01	20011318/02- RWB
				0	Whole plant	0.11	
				7	Whole plant	0.05	
				14	Whole plant	0.06	
				28	Whole plant	0.30	
				28	Ear	0.06	
				35	Straw	0.18	
				42	Straw	0.21	
Ebersheim, France, 2002  Barley/ Platine	0.0076 0.0079			35	Ear	0.03	20021228/E1- FPCE
				35	Whole plant	0.17	
				42	Straw	0.11	
Finland, 1986  Barly/ Pokko	0.0075 0.0075	- 14	Not reported	46	Straw	0.03	BV 199 (13.1.1/3

MID Maximum individual dose

MTD maximum total dose

†Reported in the 2010 JMPR evaluation as being conducted in Germany. The trial was conducted in France.

The Meeting received residue trial data conducted on barley with two applications at a rate of 0.009–0.011 kg ai/ha.

Samples were immediately frozen and maintained in frozen storage for periods of up to 5 months prior to extraction and analysis.

Samples were analysed for bifenthrin residues using method L 00.00-34. Procedural recoveries were conducted at fortification levels of 0.01–0.1 mg/kg and gave acceptable recoveries. The method has an LOQ of 0.01 mg/kg.

A summary of the residue trial data is provided in Table 21.

Table 21 Residue trial data on barley conducted in 2009

Location, Country Year, Crop/Variety	Rate (kg ai/ha)	Interval (days)	Growth stage at last application	DALA (days)	Crop part	Bifenthrin residues (mg/kg)	Reference
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## Bifenthrin

Location, Country Year, Crop/Variety	Rate (kg ai/ha)	Interval (days)	Growth stage at last application	DALA (days)	Crop part	Bifenthrin residues (mg/kg)	Reference	
GAP USA	MID: 0.016 MTD: 0.032		-	42	-	-	-	
Ploeren, France, 2009  Barley/ Platine	0.011 0.01	- 14	BBCH 83	-0 0 20 20 36	Plants Plants Ears Rest of plant Straw	0.06 0.22 0.17 0.25 0.30	S09-00395	
Burweg, Germany, 2009  Barley/ Naomic	0.01 0.011	- 13	BBCH 75	-0 0 20 20 34	Plants Plants Ears Rest of plant Straw	0.05 0.05 0.04 0.05 0.08		
Pazmand, Hungary, 2009  Barley/ Nelly	0.01 0.011	- 14	BBCH 65	23 23 38	Ears Rest of plant Straw	0.08 0.24 0.17		
Osowo, Poland, 2009  Barley/ Lomerit	0.01 0.011	- 14	BBCH 73	-0 0 20 20 35	Plants Plants Ears Rest of plant Straw	0.04 0.15 0.04 0.08 0.08		
Nottinghamshire, UK, 2009  Barley/ Pearl	0.01 0.011	- 13	BBCH 65-70	19 19 43	Ears Rest of plant Straw	0.06 0.12 0.19		
Leicestershire, UK, 2009  Barley/ Carat	0.011 0.011	- 14	BBCH 61-62	-0 0 20 20 38	Plants Plants Ears Rest of plant Straw	0.08 0.22 0.05 0.17 0.33		
Montauban, , France, 2009  Barley/ Azurel	0.01 0.01	- 14	BBCH 65	-0 0 21 21 35	Plants Plants Ears Rest of plant Straw	0.04 0.20 0.06 0.29 0.43		S09-01172
Villarreal, Spain, 2009  Barley/ Tipper	0.009 0.01	- 12	BBCH 73-75	-0 0 22 22 34	Plants Plants Ears Rest of plant Straw	0.16 0.49 0.12 0.44 0.35		

MID Maximum individual dose

MTD maximum total dose

*Oat straw*

Residue trials evaluated by the 2010 JMPR are summarized in Table 22. The trials were conducted with two applications at rates of approximately 0.007-0.008 kg ai/ha.

The 2010 JMPR concluded that the analytical and storage stability aspects of the trials were adequately addressed and covered by the available data.

Table 22 Residues data on oat straw evaluated by the 2010 JMPR

Country, year, location	Application			PHI, days	Bifenthrin residues, 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	20021228/E1/FPCE

*Triticale*

Residue trials evaluated by the 2010 JMPR are summarized in Table 23. The trials were conducted with two applications at rates of approximately 0.007–0.008 kg ai/ha.

The 2010 JMPR concluded that the analytical and storage stability aspects of the trials were adequately addressed and covered by the available data.

Table 23 Residues data on triticale straw evaluated by the 2010 JMPR

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

*Wheat*

Residue trials evaluated by the 2010 JMPR are summarized in Table 24. The trials were conducted with two applications at rates of approximately 0.007-0.008 kg ai/ha.

The 2010 JMPR concluded that the analytical and storage stability aspects of the trials were adequately addressed and covered by the available data.

Table 24 Residues data on wheat straw evaluated by the 2010 JMPR

Country, year, location	Application			PHI, days	Bifenthrin residues, mg/kg	Report
	Form	kg ai/ha	No			
France, 2003, Versailles	SC	0.008	2	27	0.17	20031328/01-RCE
				28	0.28	
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	20074083/E1-FPWW
France, 2009 Romanswiller	SC	0.01	2	35	0.35	S09-00398
France, 2009 Rouvres-St.-Jean	SC	0.01	2	35	0.35	S09-00398
Germany, 2001	SC	0.0075	2	35	0.12	20011318/02-RWW

Country, year, location	Application			PHI, days	Bifenthrin residues, mg/kg	Report
	Form	kg ai/ha	No			
Riedbach				41	0.18	
Germany, 2001 Kottmansweiler	SC	0.0075	2	35 41	0.13 0.11	20011318/01-RWW
Germany, 2001 Lutter	SC	0.0075	2	35 41	0.061 0.11	20011318/01-RWW
Germany, 2002 Riedbach	SC	0.0077	2	35 42	0.05 0.2	20011318/01-RWW
Germany, 2002 Jahnsdorf	SC	0.0978	2	35 42	0.19 0.24	20011318/01-RSWH
Germany, 2009	SC	0.01	2	35	0.20	509-00398
Greece, 2007 Kilkis, Variety Mesapia	SC	0.01	2	34	0.11	20074083/E1-EPWW
Greece, 2007 Kilkis, Variety Bronde	SC	0.01	2	34	0.27	20074083/E1-EPWW
Hungary, 2007	SC	0.01	2	33	0.14	20074083/E1-EPWW
Italy, 2007 Concelice	SC	0.01	2	35	0.30	20074083/E1-EPWW
Italy, 2007 Budrio	SC	0.01	2	30	0.43	20074083/E1-EPWW
Italy, 2009	SC	0.01	2	35	0.32	S09-01173
Poland, 2007	SC	0.01	2	35	0.17	20074083/E1-EPWW
Spain, 2009	SC	0.01	2	35	0.11	SOP-01173
UK, 2002	SC	0.003	2	43	0.24	20021228/E1/FPCE
UK, 2009 North Cave Variety Robicus	SC	0.01	2	62	0.51	S09-00398

### **FATE OF RESIDUES DURING PROCESSING**

The effects on the nature of the residue during processing were evaluated by the 2010 JMPR. Bifenthrin was found to be hydrolytically stable.

The current meeting received no additional information on the magnitude of residues in processing.

### **APPRAISAL**

Bifenthrin is a pyrethroid insecticide and miticide. It was first evaluated for residues and toxicology by the JMPR in 1992 and re-evaluated in 2009 (T), 2010 (R) and 2015 (R).

An ADI of 0–0.01 mg/kg bw and an ARfD of 0.01 mg/kg bw was established by the 2009 JMPR. The residue definition for compliance with MRLs and for estimation of dietary intake (for animal and plant commodities) is bifenthrin (sum of isomers). The residue is fat-soluble.

At the Fiftieth Session of the CCPR (2018), bifenthrin was scheduled for evaluation of additional uses. The current Meeting received new residues data and GAP information for mango, cucumber, okra and barley. In addition, new GAP information was provided for strawberry.

### ***Methods of Analysis***

Residues were determined in the crops using several different analytical methods. In general, the data generation methods considered by this Meeting involved extraction with either acetone or ethyl acetate. Final determination was achieved using GC-MS, GC-MS/MS or GC-ECD. The validated LOQs for okra and barley grain were 0.01 mg/kg. For cucumber the validated LOQ was 0.1 mg/kg. For mango the validated LOQs for the different methods used ranged from 0.02–0.1 mg/kg.

The meeting concluded that suitable methods are available for the determination of bifenthrin in mango, cucumber, okra and barley.

### ***Stability of residues in stored analytical samples***

The 2010 and 2015 JMPR concluded that residues of bifenthrin were stable for at least 18 months when stored at  $\leq -18$  °C (high acid), 49 months (high water), 36 months (high oil), 36 months (high starch) and 15 months (high protein).

The Meeting agreed that the new storage stability data for head cabbage, barley grain and barley straw confirms the stability of bifenthrin when stored at  $\leq -18$  °C. The Meeting concluded that the new storage data for cucumber and okra were of limited use owing to missing information in the studies.

The overall data were sufficient to support the storage intervals in the residue trials.

### ***Results of supervised residue trials on crops***

The meeting received residue trial data and GAP information for strawberry, mango, cucumber, okra and barley.

#### ***Strawberry***

A new GAP was provided for strawberry. The GAP is for the USA and involves four applications of 0.11 kg ai/ha with a PHI of 3 days.

The Meeting received information that confirmed that the more critical use considered by the 2010 JMPR is still authorized in the USA. The application rate is 0.045–0.22 kg ai/ha per application with a total dose not exceeding 0.56 kg ai/ha. No PHI was defined.

The Meeting confirmed its previous recommendation of a maximum residue level of 3 mg/kg, STMR of 0.46 mg/kg and a HR of 2.3 mg/kg.

The Meeting noted that the ARfD was exceeded for children (380% of the ARfD) and the general population (210% of the ARfD).

No alternative GAP was available from another country.

#### ***Mango***

The critical GAP for mango is in Brazil with 1 application of 0.003 kg ai/hL with a PHI of 7 days.

Trials were available from Brazil, Mali, the Philippines and Senegal. The three trials conducted in Brazil matched the GAP.

Residues in mango at a PHI of 7 days were (n = 3): < 0.02 (2) and < 0.04 mg/kg.

The Meeting concluded that three trials were insufficient to estimate a maximum residue level for mango.

### *Cucumber*

The critical GAP for cucurbits is in the USA with three applications at 110 g ai/ha with a minimum interval between applications of 7 days and a PHI of 3 days.

One trial supports the GAP.

Residues in cucumber at a PHI of 3 days from trials approximating the GAP were (n = 1): < 0.1 mg/kg.

The Meeting concluded that one trial is insufficient to estimate a maximum residue level for cucumber.

### *Okra*

The critical GAP for okra is in the USA with two applications at 110 g ai/ha, an interval between applications of 7 days and a PHI of 7 days.

The residue trials evaluated by the 2010 JMPR do not reflect the GAP. However, the Meeting agreed that three of the trials could be scaled to the GAP using the proportionality principle.

The unscaled residues in okra at a PHI of 7 days were (n = 3): 0.01, 0.02 and 0.04 mg/kg.

The scaled residues (scaling factor of 2.75) in okra at a PHI of 7 days (in rank order) were (n = 3): 0.028, 0.055, 0.11 mg/kg

The Meeting agreed that three trials were insufficient to estimate a maximum residue level for okra.

The GAP in India is one application of 59 g ai/ha followed by a second application of 62 g ai/ha. The retreatment interval is not stated. The PHI is 5 days.

This Meeting received trials from India approximating the GAP.

Residues in okra at a PHI of 5 days in rank order were (n = 4): < 0.01 (2), 0.014, 0.018 mg/kg.

The Meeting concluded that four trials were insufficient to estimate a maximum residue level for okra.

### *Cereals*

The critical GAP for cereals is in Switzerland with two applications at 0.016 kg ai/ha and a PHI of 42 days.

#### *Barley*

The Meeting noted that the residue trials considered by the 2010 JMPR and the trials considered by this Meeting were conducted at a lower application rate compared to the GAP. However, the trials could be scaled using the proportionality principle, except where residues were reported as < 0.01 mg/kg. It was also noted that the PHI varied within the trials. The Meeting agreed that only trials with samples taken 40–44 DALA could be used to support the GAP. Four trials were considered to support the GAP.

The unscaled residues in barley (in rank order) were (n = 4): 0.01 and 0.02 (3) mg/kg

The scaled residues (scaling factors of 1.45–2.13) in barley were (n = 4): 0.02, 0.03 and 0.04 (2) mg/kg.

The Meeting concluded that four trials were insufficient to estimate a maximum residue level for barley.

### *Oats, triticale and wheat*

The 2010 JMPR evaluated residue trial data on oats, triticale and wheat. Although the trials were all conducted at lower application rates compared to the GAP, the number of applications and the PHI matched the GAP for some of the trials. However, as residues were < 0.01 mg/kg scaling of the residues using the proportionality principle was not possible.

The Meeting concluded that the trials were not suitable for estimating maximum residue levels for oats, triticale and wheat.

### *Residues in animal feed*

#### *Cereal forage*

The critical GAP for cereals is in Switzerland. Grazing of forage from cereal grain crops is not common practice in Europe and is precluded in conjunction with agricultural chemical use unless specifically allowed by label instructions. Median and highest residues for barley forage have therefore not been estimated.

#### *Cereal Straw*

The critical GAP for cereals is in Switzerland with two applications at 0.016 kg ai/ha and a PHI of 42 days.

Residue trials on barley, oats, triticale and wheat were evaluated by the 2010 JMPR. None of the trials matched the GAP. However, the Meeting agreed that the trials could be scaled using the proportionality principle. The Meeting noted that the DALA varied and the Meeting agreed that only trials with 40–44 DALA could be used to support the GAP.

Thirteen trials conducted on cereal straws support the GAP when the proportionality principle is applied.

The unscaled residues in cereal straw were (n = 13): 0.059, 0.074, 0.09, 0.11 (3), 0.12, 0.18 (2), 0.19, 0.2, 0.21 and 0.24 mg/kg (as received).

The scaled residues (scaling factors of 1.45–2.13) in cereal straw were (n = 13): 0.12, 0.15, 0.19, 0.22, 0.23 (2), 0.26, 0.28, 0.38 (2), 0.39, 0.42 and 0.45 mg/kg (as received).

The Meeting estimated a highest residue of 0.45 mg/kg (as received), a median residue of 0.26 mg/kg (as received) and a maximum residue level of 1 mg/kg (dw), using a correction factor of 90% for dry matter, for straw and fodder (dry) of cereal grains.

### *Residues in animal commodities*

#### *Straw can be fed to livestock.*

Dietary burdens were calculated for beef cattle, dairy cattle, broilers and laying poultry based on feed items evaluated by the JMPR. The dietary burdens, estimated using the OECD diets listed in Appendix IX of the 2016 edition of the FAO manual, are presented in Annex 6.

The maximum total dietary burdens calculated in 2010 were 8.3 ppm (beef cattle), 7.4 ppm (dairy cattle), 0.59 ppm (poultry broiler) and 2.0 ppm (poultry layer). The maximum total dietary burdens calculated by the current Meeting using the OECD diets were 8.5 ppm (beef cattle), 7.6 ppm (dairy cattle), 0.59 (poultry broiler) and 1.5 ppm (poultry layer).

The Meeting noted that the contribution of straw to the dietary burden was less than 10% of the maximum total dietary burden estimated by the 2010 JMPR and did not change the estimated residues in milk, eggs and tissues. The Meeting therefore confirmed its previous recommendations for maximum residue levels in animal products.

## 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 assessments.

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

The residue is fat-soluble.

Table 1 Residue levels suitable for establishing maximum residue limits and for IEDI and IESTI assessments for bifenthrin

CCN	Commodity name	Recommended maximum residue level, mg/kg		STMR or STMR-P, mg/kg	HR or HR-P, mg/kg
		New	Previous		
FB 0275	Strawberry <sup>a</sup>	3 <sup>a</sup>	3	0.46	2.3
AS 0081	Straw and fodder (dry) of cereal grains	1 (dw)	-	Median: 0.26 (ar)	0.45 (ar)

<sup>a</sup> On the basis of information provided to the JMPR it was concluded that the estimated acute dietary exposure to residues of bifenthrin from the consumption of strawberry may present a public health concern

dw – dry weight; ar – as received

## DIETARY RISK ASSESSMENT

### Long-term dietary exposure

The ADI for bifenthrin is 0–0.01 mg/kg bw. The International Estimated Daily Intakes (IEDIs) of bifenthrin were estimated for the 17 GEMS/Food Consumption Cluster Diets using the STMR values estimated by the JMPR in this Meeting and in 2010 and 2015. The results are shown in Annex 3 of the 2019 JMPR Report.

The IEDIs ranged from 10–40% of the maximum ADI. The Meeting concluded that long-term dietary exposure to residues of bifenthrin resulting from the uses considered by the current and previous Meetings are unlikely to present a public health concern.

### Acute dietary exposure

The ARfD for bifenthrin is 0.01 mg/kg bw. The International Estimate of Short Term Intakes (IESTIs) for bifenthrin were calculated for the food commodities and their processed commodities for which HRs and STMRs were estimated by the present Meeting and for which consumption data were available. The results are shown in Annex 4 of the 2019 JMPR Report.

The IESTIs varied from 2–380% of the ARfD for children and 1–210% of the ARfD for the general population.

The Meeting concluded that acute dietary exposure to residues of bifenthrin from the consumption of strawberry may present a public health concern.

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## REFERENCES

Author	Report No./Trial ID	Year	Title, Institute
Location 1 VRS Pantnagar	Banerjee, K., Shabeer, A., Sawant, S.D.	2015	Evaluation of Propargite 50% + Bifenthrin 5% SE residues in okra Report No. Not given FMC Reference: Location 1 VRS Pantnagar Non-GLP; Unpublished 2015



Author	Report No./Trial ID	Year	Title, Institute
Location 2 CRS Bhubaneswar	Banerjee, K., Shabeer, A., Sawant, S.D.	2015	Evaluation of Propargite 50% + Bifenthrin 5% SE residues in okra Report No. Not given FMC Reference: Location 2 CRS Bhubaneswar Non-GLP; Unpublished 2015
Location 3 UAS Hiriyur	Banerjee, K., Shabeer, A., Sawant, S.D.	2015	Evaluation of Propargite 50% + Bifenthrin 5% SE residues in okra Report No. Not given FMC Reference: Location 3 UAS Hiriyur Non-GLP; Unpublished 2015
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**Bifenthrin**

Author	Report No./Trial ID	Year	Title, Institute
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FMC-0901	Wiesner, F., Breyner, N	2010	Storage Stability Study of Residues of Bifenthrin Enantiomers in Head Cabbage and Barley Report No. FMC-0901 FMC Reference: BI 13.9/3 GLP; Unpublished 23 Dec 2010