FLUFENOXURON (275)

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EXPLANATION

Flufenoxuron is a benzoylurea insect growth regulator with high levels of acaricidal activity. Flufenoxuron kills pest mites and insects through interference with chitin production during cuticle development in mite and insect juvenile stages. Flufenoxuron has limited to no effect on adult mites and insects. It is registered for use in a variety of crops worldwide.

IDENTITY

ISO common name: Flufenoxuron

Chemical name

IUPAC: N-{4-[2-chloro-4-(trifluoromethyl)phenoxy]-2-fluorophenyl}-N'-(2,6-difluorobenzoyl)urea

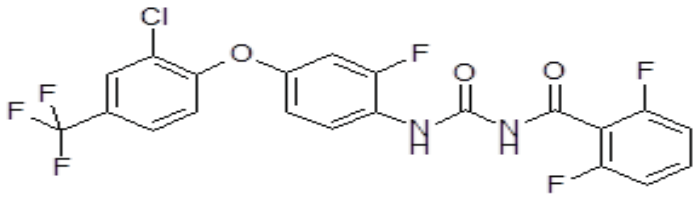
CAS: N-[[[4-[2-chloro-4-(trifluoromethyl)phenoxy]-2-fluorophenyl]amino]carbonyl]-2,6-difluorobenzamide

CAS Registry No: 101463-69-8

CIPAC No.: 470

Synonyms and Trade Name: WL115110, Cascade

Structural formula:



Molecular formula: $C_{21}H_{11}Cl\,F_6N_2O_3$

Molecular mass: 488.8 g/mol

Physical and Chemical Properties

Pure active ingredient, minimum purity 99.0%

Chemical/physical property	Results	Reference	Guidelines
Vapour Pressure (20 ºC)	6.52×10^{-9} mPa	FX-390-025 (2000/7000541)	EU Directive 91/414
Melting point	167–172 °C	FX-303-002	
Partition coefficient (25 ºC)	pH 4 : log P = 3.99 pH 7 : log P = 4.00 pH 9 : log P = 4.00	FX-301-002 (1988/7000758)	
Relative density (~22 ºC)	1.649	Kaestel 2001a, 2001/1019524	OECD Test Guideline 109
Henry's law constant (25 ºC)	7.46×10^{-6} Pa.m^3.mol^{-1}	FX-390-025 (2000/7000541)	EU Directive 91/414
Physical state, colour, odour	white, crystalline powder with a sourish odour.	Kaestel 2001b, 2001/1009097	EU Directive 91/414
Solubility in water [µg/L] (25 °C)	pH 4 : 1.86 pH 7 : 1.36 pH 9 : 3.69	Langner 1988a, FX-301-002 (1988/7000758)	

Chemical/physical property	Results	Reference	Guidelines
	Flufenoxuron is almost insoluble in water.		
Solubility in organic solvents [g/L] (20 °C[a])	n-heptane: < 0.01 n-octanol: 1.1 toluene: 3.5 dichloromethane: 16 methanol: 3.5 acetone: 83 ethyl acetate 55 acetonitrile: 6.62	Daum 2001a, FX-301-002 (2001/1017469)	OECD 105
Hydrolysis rate	Hydrolysis has been investigated at 50 °C at pH 5, 7 and 9. At pH 5 and 7: flufenoxuron is hydrolytically stable (half-life > 1 year). At pH 9 : > 87% of flufenoxuron was degraded after 5 days at 50 °C. Degradation was investigated at 60 °C and 70 °C, and half-life extrapolated at 25 °C was found to be 76 days.	Langner 1988a, FX-301-002 (1988/7000758)	
Photochemical degradation	Flufenoxuron decomposes under photolysis into 2,6-difluorobenzamide (maximum 84.5% at DAT 7), with a DT_{50} of 4.5 days under continuous irradiation at pH 7 and 22 °C. No counterpart metabolites were observed. Dark samples showed no degradation.	Hassink 2003a, 2003/1000986	
Quantum yield	$\Phi = 1.75 \times 10^{-3}$ for the radiolabelled active ingredient However the DT_{50} of the fluoroaniline radiolabelled active substance was poorly determined. For $290 < \lambda < 775$ nm : $\Phi = 2.2\ 10^{-3}$ mol. einstein^{-1}	Hassink 2003a, 2003/1000986	
Dissociation constant	pKa = 10.1	Camilleri & Langner 1986a, FX-311-002 (1986/7000994)	

[a] Purity 99.2%

Technical material; minimum purity 97.4%

Chemical/physical property	Results	Reference	Guidelines
Appearance	white, fine powder with a spicy odour.	Kaestel 2001c, 2001/1009099	
Relative density (20 °C [a])	1.57	Langer 1988a, FX-301-002 (1988/7000758)	

Chemical/physical property	Results	Reference	Guidelines
Flammability	Not flammable [b]	Van Helvoirt 1990a, FX-330-001 (1990/7001093)	EEC-Directive A-10
Auto-flammability	Not self-igniting [b]	Van Helvoirt 1990b, FX-330-002 (1990/7001094)	EEC-Directive A-16
Explosive properties	Not explosive [b]	Van Helvoirt & Cardinaals 1990a, FX-334-001 (1990/7001095)	EEC-Directive A-14
Oxidising properties	Not oxidising [b]	Van Helvoirt 1990c, FX-356-001 (1990/7001096)	EEC-Directive A-17

[a] Purity 97.4%
[b] Purity 97.6%

Formulation

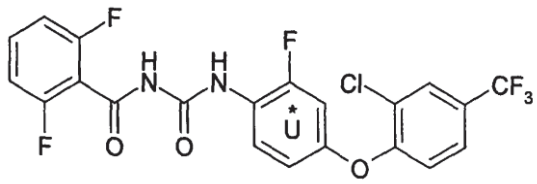
Flufenoxuron is commercially marketed as an emulsifiable concentrate containing 10% flufenoxuron.

Specification

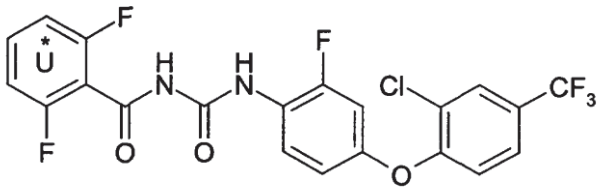
Flufenoxuron has not been evaluated by the Joint Meeting of Pesticide Specifications.

METABOLISM AND ENVIRONMENTAL FATE

The metabolism and distribution of flufenoxuron in plants and animals was investigated using ^{14}C-labelled test materials as shown below:

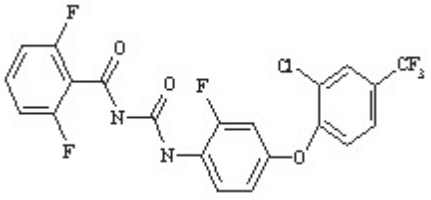


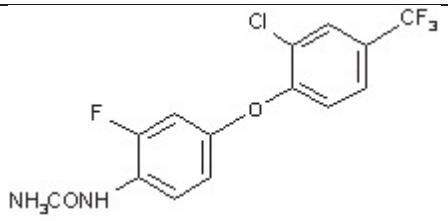
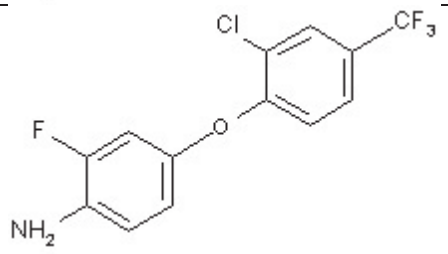
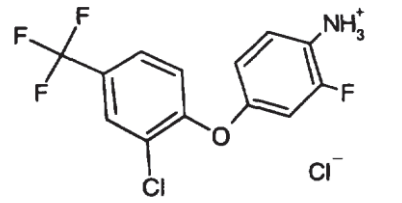
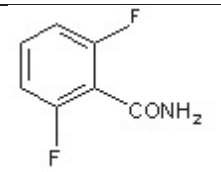
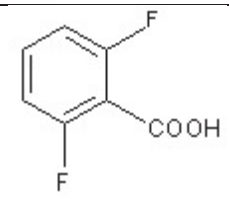
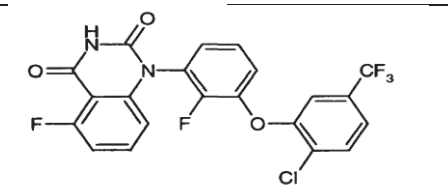
Fluoroaniline-U-^{14}C



Difluoroamide-U-^{14}C

Common chemical names, code names and structures of the parent and metabolites are captured below:

Code	*Structure*	*Occurrence*
Flufenoxuron WL115110 *N*-{4-[2-chloro-4-(trifluoromethyl)phenoxy]-2-fluorophenyl}-*N*'-(2,6-difluorobenzoyl)urea		Rat Lactating goat Laying hen Grape Apple Tomato Chinese cabbage Soil Hydrolysis study

Code	*Structure*	*Occurrence*
Reg. No. 4064702 *N*-{4-[2-chloro-4-(trifluoromethyl)phenoxy]-2-fluorophenyl}urea		Rat Laying hen Hydrolysis study
Reg. No. 241208 4-[2-chloro-4-(trifluoromethyl)phenoxy]-2-fluoroaniline		Rat Laying hen Hydrolysis study
Reg. No. 4064703 (chloride salt of Reg. No. 241208) 4-[2-chloro-4-(trifluoromethyl)phenoxy]-2-fluoroaniline hydrochloride		Hydrolysis study
Reg. No. 102719 2,6 difluorobenzamide		Rat Hydrolysis study
Reg. No. 206925 2,6-difluorobenzoic acid		Rat Hydrolysis study
Reg. No. 4964847 1-{3-[2-chloro-5-(trifluoromethyl)phenoxy]-2-fluorophenyl}-5-fluoro-2,4(1H, 3H)-quinazolinedione		Hydrolysis study

Animal metabolism

The Meeting received information on the fate of [^{14}C]flufenoxuron in a lactating goat and laying hens. The lactating goat metabolism study was carried out with [^{14}C]flufenoxuron uniformly labelled at the fluoroaniline ring while the laying hen metabolism study was carried out with uniformly ^{14}C-labelled difluoroamide- and fluoroaniline-flufenoxuron. Metabolism in laboratory animals (rat) was summarised and evaluated by the WHO panel of the 2014 JMPR.

Lactating goat

The metabolism of [^{14}C]flufenoxuron was investigated in one lactating goat, weighing 73 kg, was dosed orally by gavage with 2-fluoroaniline-[U-^{14}C]-ring-labelled flufenoxuron once daily for 4 consecutive days at a dose level of 10 mg/day equivalent to 10 ppm in the diet. Milk production

ranged from 1.2–2.8 L/day. During the treatment period, milk was collected twice daily while urine and faeces were collected once daily. At sacrifice (within 24 hours after the last dose) samples of liver, kidney, muscle (hind leg and dorsal) and fat (deep body fat store along spine and renal) were collected.

The major route of elimination of the radioactivity was via the faeces which accounted for 18% of the total administered radioactivity (TAR); while urine accounted for 2.5% of the TAR and milk accounted for 8.3% of the TAR. Overall, the tissue burden was low, accounting for < 2% of the TAR. No further justification was provided for the low overall recovery of administered radioactivity (33% of the TAR).

The total radioactive residues (TRRs) were highest in fat (1.6 mg eq/kg), followed by liver (0.37 mg eq/kg), kidney (0.13 mg eq/kg) and muscle (0.076 to 0.1 mg eq/kg).

Table 1 Radioactive residue in organs and tissues

Organ/tissue	TRR [mg eq/kg]
Liver	0.37
Kidney	0.13
Skeletal muscle	
Hind leg	0.076
Dorsal	0.1
Deep body fat	1.6
Renal fat	1.6
Bile	0.26 mg eq/L
Whole blood	0.029 mg eq/L

Milk residues peaked on day 4 (average of 0.27 mg eq/L) with the highest concentrations of radioactivity detected in the cream fraction (accounting for 82–93% of the TRR in whole milk) and the lowest found in whey (1.3–5.7% of the TRR).

Table 2 ^{14}C-Residues in milk of goat dosed with 10 mg/day of 2-fluoroaniline-[U-^{14}C]-ring-labelled flufenoxuron

Day	Time (hours) [a]	TRR (mg eq/L)
1	7	0.27
2	23	0.09
	31	0.39
3	47	0.13
	55	0.23
4	71	0.16
	79	0.37
5	95	0.23

[a] Time after administration of first dose

Samples of tissues and milk were further analysed for determination of the distribution and composition of the total radioactivity. Liver and kidney samples were homogenised with ethyl acetate/methanol, muscle and fat samples were homogenised with dichloromethane while milk samples were mixed with potassium oxalate, ethanol and diethyl ether, all prior to partitioning with hexane and acetonitrile.

Aliquots of the acetonitrile phases of milk, liver, kidney, muscle and fat were mixed with appropriate amounts of the reference compound and subjected to HPLC/UV analysis.

Table 3 Characterisation of ^{14}C residues in tissues and milk of goat dosed with 2-fluoroaniline-[U-^{14}C]-ring-labelled flufenoxuron

Sample	% TRR Initial extraction efficiency	Acetonitrile/ hexane partition		Final recovery in acetonitrile fraction [%]
		% TRR in hexane fraction	% TRR in acetonitrile fraction	
Liver	93.4	3.8	88.5	82.8

Sample	% TRR Initial extraction efficiency	Acetonitrile/ hexane partition		Final recovery in acetonitrile fraction [%]
		% TRR in hexane fraction	% TRR in acetonitrile fraction	
Kidney	91.4	16.1	89.8	82.0
Muscle	66.2	9.8	114.5	63.5
Fat	99.8	1.5	115.3	107.4
Milk	98.3	0.0	81.1	81.1

Extraction of the samples collected recovered 64–107% of the TRR. HPLC/UV analysis of the extracts showed no evidence of cleavage of the flufenoxuron molecule or any metabolism of the parent substance in the goat. Hence, the parent compound remained intact with no other substances being detected in the analytical chromatograms.

The nature of the radioactivity in fat analysed after a 3–4 month storage period at –20 °C was examined by HPLC. No differences were noted in the metabolic profile.

Laying Hen

Study 1

Laying hens were dosed once daily for 14 consecutive days with flufenoxuron, uniformly labelled in the difluoroamide or fluoroaniline rings, at 13–14 ppm feed, equivalent to 0.78–0.85 mg/kg bw. Eggs were collected twice daily, in the morning before and in the afternoon after administration, whilst excreta was collected once daily. The animals were sacrificed approximately 23 h after the last dose and the liver, muscle and fat were collected and pooled per dose group. Liquid samples were measured directly by LSC while solid samples were combusted prior to analysis by LSC.

Excreta accounted for 72–78% of the TAR. Although no plateau was reached in eggs during the dosing period (14 days), the radioactivity recovered in eggs amounted to 1.0–1.3% of the TAR (0.5–0.8 mg eq/kg). Among all the tissues analysed, radioactive residues were highest in fat (5.0–5.3 mg eq/kg) followed by liver (0.6–1.1 mg eq/kg) and muscle (0.3–0.4 mg eq/kg). The total recovery of radioactivity was 82% and 77% in the difluoroamide-label and fluoroaniline-label groups, respectively.

Table 4 Recovery of radioactive residues in laying hens

Matrix	Difluoroamide label		Fluoroaniline label	
	% TAR	mg eq./kg	% TAR	mg eq./kg
Excreta	78.41		71.59	
Eggs	0.98		1.28	
Blood	0.02	0.113	0.40	1.269
Liver	0.11	0.577	0.24	1.056
GI-Tract (skin)	0.47	0.504	0.39	0.369
GI-Tract (contents)	0.06	0.252	0.06	0.213
Muscle	0.58	0.326	0.71	0.364
Adipose tissue	1.33	5.041	1.85	5.318
Subtotal organs	2.57		3.65	
Cage wash	0.13	–	0.11	–
Total	82.09	–	76.66	–

Extraction of radioactive residues from tissues and organs was initially performed with methanol, with the extractability ranging from 91–102% and 88–99% of the TRR for the difluoroamide- and fluoroaniline-labels, respectively. While the lowest extractability occurred with the liver from the fluoroaniline-label (88% of the TRR), microwave extraction of the liver post-extraction solid (PES) released another 8% of the TRR. Further characterisation according to polarity of residues was completed by partitioning with ethyl acetate/ water and acetonitrile/iso-hexane (for

fat, eggs and muscle) where the majority of the radioactivity was recovered in the ethyl acetate phase (93–101% and 82–104% of the TRR, difluoroamide- and fluoroaniline-label, respectively).

Table 5 Distribution of ^{14}C-residues in eggs and tissues

Label	Sample	TRR [mg/kg]	ERR [a] [mg/kg] (%TRR)	PES [b] [mg/kg] (%TRR)	Recovery [%] [c]
Difluoroamide	Egg	0.570	0.577 (101.3)	0.006 (1.0)	102.3
	Fat	5.041	5.088 (100.9)	0.011 (0.2)	101.1
	Liver	0.577	0.586 (101.5)	0.010 (1.7)	103.2
	Muscle	0.326	0.297 (91.3)	0.002 (0.7)	92.0
	Excreta [d]	4.082	4.065 (99.6)	0.018 (0.4)	100.0
Fluoroaniline	Egg	0.794	0.770 (97.1)	0.022 (2.8)	99.9
	Fat	5.318	5.258 (98.9)	0.038 (0.7)	99.6
	Liver	1.056	0.930 (88.1)	0.144 (13.6) [e]	101.7
	Muscle	0.364	0.341 (93.7)	0.014 (3.8)	97.5
	Excreta [d]	3.757	3.676 (97.8)	0.081 (2.2)	100.0

[a] ERR = Extracted Radioactive Residue (methanol)
[b] PES = Post-Extraction Solid
[c] Sum of all extracts and the residue
[d] Calculated value from ERR and PES
[e] Another 7.9% of the TRR was extracted by microwave treatment

For the difluoroamide-label, the parent was the only analyte identified in eggs, muscle, fat and liver ranging from 0.28 mg eq/kg (86.5% of the TRR, muscle) to 4.6 mg eq/kg (91.4% of the TRR, fat).

For the fluoroaniline-label, while the parent compound and the metabolite Reg. No. 4064702 were both identified in the eggs, muscle, fat and liver, the parent accounted for the majority of the TRRs (70–91%). The lowest level of parent was found in muscle with 0.30 mg eq/kg and the highest level in fat with 4.8 mg eq/kg. In eggs and liver, Reg. No. 4064702 was present at 0.10 mg eq/kg and 0.13 mg eq/kg (12.0% and 12.6% of the TRR), respectively. Reg. No. 4064702 was detected in muscle and fat as a minor metabolite amounting to 0.02 mg eq/kg and 0.05 mg eq/kg, respectively (5.5% and 1.0% of the TRR). The formate derivative of Reg. No. 241208 was released from the PES of liver after microwave treatment in the presence of formic acid/acetonitrile. The radioactivity associated with this derivative amounted to 0.04 mg eq/kg (3.3% TRR). The Meeting could not confirm whether the metabolite Reg. No. 241208 is an actual in-vivo metabolite or an artefact formed during microwave treatment.

Table 6 Identification of total radioactive residues in eggs and tissues

Label	Structure	Eggs [mg/kg] (%TRR)	Muscle [mg/kg] (%TRR)	Fat [mg/kg] (%TRR)	Liver [mg/kg] (%TRR)
Difluoroamide	Flufenoxuron	0.514 (90.3)	0.282 (86.5)	4.610 (91.4)	0.597 (103.5)
Fluoroaniline	Flufenoxuron	0.620 (78.2)	0.302 (82.9)	4.840 (91.0)	0.738 (69.9)
	Reg. No. 4064702	0.095 (12.0)	0.020 (5.5)	0.051 (1.0)	0.133 (12.6)

Label	Structure	Eggs [mg/kg] (%TRR)	Muscle [mg/kg] (%TRR)	Fat [mg/kg] (%TRR)	Liver [mg/kg] (%TRR)
	Reg. No. 241208	–	–	–	0.035 [a] (3.3)

[a] Amount of Reg. No. 241208 released from liver PES by microwave treatment

Study 2

Five groups (groups 1–5 and 7–10) of three laying hens each (White Leghorn hybrids, 1.4–2.1 kg) were dosed orally by gavage with 2-fluoroaniline-[U-^{14}C]-ring-labelled flufenoxuron once daily for seven consecutive days at a dose level of 10 mg/kg feed (corresponding to 0.5 mg/kg bw). One group of six untreated hens (group 6) served as a background control group.

Excreta from every group of hens was combined and sampled at 24 h intervals during administration. Eggs of individual hens were collected daily before each administration. After the final administration, before sacrifice, eggs and excreta were collected. Hens were sacrificed 22 hours after the final dosage or 2, 9, 16, and 34 days after the last dose to investigate the depuration behaviour of the flufenoxuron, liver, kidney, muscle (composite of breast and thigh muscle), gizzard (without lining and contents), heart, omental fat and skin were sampled. The content of the gizzard was added to the residual carcass.

On average, 26% of the TAR was excreta-related with eggs, sampled from 0–166 h after the first administration, accounting for 5% of the TAR. At sacrifice, the highest amount of radioactive residues was detected in fat (47% of the TAR), followed by skin (12% of the TAR), muscle (4% of the TAR), liver (2% of the TAR), kidney (0.3% of the TAR), heart and gizzard. The recovery of radioactivity amounted to 96% of the TAR.

Table 7 Balance of radioactivity (means of 15 hens) after seven daily doses of 0.5 mg/kg [^{14}C]-flufenoxuron sacrificed 22 hr after final dosage

Matrix	% TAR	mg eq./kg
Excreta	25.3	
Cage wash	0.6	
Eggs	4.7	6.0 egg yolks 0.02 egg whites
Liver	1.5	2.28
Kidney	0.3	1.26
Muscle	4.1	3.9
Fat	47.0	14.3
Skin	11.9	3.9
Heart	0.2	0.86
Gizzard		0.44
Total	95.6	

Table 8 Extractability of radioactivity from different organs of laying hens

Organ/tissue	TRR [mg/kg]	Acetone extract		Unextracted residue		% Recovery (extracted + unextracted)
		[mg eq/kg]	%TRR	[mg eq/kg]	%TRR	
Liver [a]	2.28	2.22	97.0	0.22	9.5	106
Kidney [a]	1.26	1.14	90.0	0.16	12.5	102
Muscle	0.38	0.38	102.0	0.03	8.1	110
Gizzard	0.44	0.41	94.2	0.05	11.7	106
Heart	0.86	0.83	96.5	0.09	10.2	107

Organ/tissue	TRR [mg/kg]	Acetone extract		Unextracted residue		% Recovery (extracted + unextracted)
		[mg eq/kg]	%TRR	[mg eq/kg]	%TRR	
Fat	14.3	12.94	90.5	0.03	0.2	91
Skin + adj. fat	3.9	3.58	91.9	0.02	0.6	92

[a] After incubation at 37 °C.

Extraction of the samples collected recovered > 90% of the TRR. HPLC/UV analysis of the extracts showed that flufenoxuron was not extensively metabolized and accounted for the majority of the radioactivity in egg yolks, liver, kidney, muscle, gizzard and heart while it was the only compound detected in fat and skin. Hydrolysis of the benzoyl urea bond resulted in the formation of fluoroaniline-label specific minor metabolites Reg. No. 4064702 and Reg. No. 241208.

The metabolite Reg. No. 4064702 was detected in yolks, liver, kidney, muscle, gizzard, and heart at 6–22% of the TRR. The minor metabolite Reg. No. 241208 was only detected in liver and kidney (≤ 4% of the TRR). The Meeting noted that liver and kidney were the only matrices that were incubated for 16 hours at 37 °C in 0.07 M phosphate buffer at pH 7.5 prior to extraction. However, the Meeting could not confirm that this metabolite is an artefact of the analytical procedure.

Additionally, one to three unknown radioactive fractions in yolks, liver and kidney extracts were detected (all below 10% of the TRR). In liver, three unknown fractions were characterized that were less polar than the reference items. The unknown fraction from yolks and kidney had a similar TLC-behaviour.

Table 9 Identification of total radioactive residues in eggs and tissues (%TRR)

Identity	Yolks	Liver	Kidney	Muscle	Gizzard	Heart	Fat	Skin
Flufenoxuron	84.9	66.3	59.6	90.4	89.5	90.3	98.2	97.2
REG. NO. 4064702	6.3	10.4	21.6	9.3	10.2	9.3	n.d.	n.d.
REG. NO. 241208	n.d.	3.7	2.5	n.d.	n.d.	n.d.	n.d.	n.d.
Total Identified	91.2	80.4	83.7	99.7	99.7	99.6	98.2	97.2
Total characterized (number of fractions)	8.8 (1)	2.9–7.6 (3)	8.9 (1)	–	–	–	–	–
Total Unidentified	–	4.0	7.4	0.3	0.3	0.4	1.8	2.8
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

The depuration study indicated that the radioactivity in egg yolks and muscle decreased steadily up to day 34. In kidney and liver, the decrease in radioactivity was more prominent from day 16 to day 34 of the depuration phase yet in fat, the decrease in radioactivity occurred most rapidly from day 2 to day 9 and from day 16 to day 34. These results demonstrated that radioactive residues are not retained in eggs, organs and tissues after cessation of dosing.

Overview of metabolism in livestock

In the lactating goat metabolism study, the parent flufenoxuron remained intact and was the only residue identified in milk and tissues.

In the laying hen metabolism studies, while flufenoxuron was the predominant residue in eggs and organs/tissues, cleavage of the benzoyl urea bond was observed to a limited extent resulting in the formation of minor metabolites Reg. No. 4064702 (eggs and tissues) and Reg. No. 241208 (liver and kidney).

Plant metabolism

Metabolism studies on tomato, apple, grape and Chinese cabbage were made available to the Meeting.

Grape

Grape-vine plants, variety Muller-Thurgau, grown outdoor and protected with plastic covers after application, were separately treated with [difluorobenzamide-U-^{14}C]- and [fluoroaniline-ring-U-^{14}C]flufenoxuron formulated as flowable concentrate formulations. Two foliar sprays were made during fruit development at a rate of 0.04 kg ai/ha/application with a 40-day retreatment interval. Mature samples of stalks and fruit (from grape clusters) were collected 28–29 days after last treatment (DAT), while leaves were collected at 15 DAT (immature) and 28–29 DAT (mature).

Total radioactive residues (TRRs) in leaves from the applications using difluorobenzamide-label were 2.7 mg eq/kg at 15 DAT and declined to 1.8 mg eq/kg at 29 DAT (Table 10). TRRs in mature fruit and stalks (29 DAT) were 0.014 mg eq/kg and 0.16 mg eq/kg, respectively. TRRs in leaves from applications using the fluoroaniline-label declined from 2.3 mg eq/kg at 15 DAT 1.4 mg eq/kg at 28 DAT. TRRs in mature fruit and stalks (28 DAT) were 0.012 mg eq/kg and 0.11 mg eq/kg, respectively. Overall, the distribution of radioactivity was relatively similar among both radiolabels.

Homogenized samples of fruit, leaf and stalk samples were extracted three times with methanol (MeOH) and twice with water. After each extraction step, the liquid phase was separated from the post extraction solid (PES) by centrifugation. The extracts and the dried PES were analysed by combustion for the determination of the residual radioactive residues. Aliquots of the MeOH extracts were evaporated to dryness, reconstituted in water and partitioned three times with hexane followed by three partition steps of the remaining aqueous phase with ethyl acetate. Aliquots of the organic and aqueous phases were analysed by LSC. Residues were identified by reverse-phase HPLC-UV and the identity of parent flufenoxuron was confirmed by HPLC with a Polymeric Reversed Phase (PRP-1) column.

As reported in Tables 10 and 11, approximately 95–97% of the TRR (0.012–2.6 mg eq/kg) was extracted from the grape matrices for both radiolabels. In all fruit, leaf and stalk samples (both labels), parent flufenoxuron was the only compound identified at 50–97% of the TRR (0.007–2.2 mg eq/kg). Polar unknowns comprised up to 40–46% of the TRR in mature grape samples (0.005–0.006 mg eq/kg) for both radiolabels. Unextracted residues in all leaf, fruit and stalk samples comprised ≤ 5% of the TRR (< 0.11 mg eq/kg), resulting in overall accountabilities of 99–100%.

The only metabolic reaction observed in grape matrices was the breakdown of flufenoxuron to mainly polar metabolites.

Table 10 Total radioactive residues (TRR) in grape matrices following two foliar applications of [^{14}C]-flufenoxuron at 0.08 kg ai/ha/season

Matrix	DAT (days)	TRR [a] (mg eq/kg)	Distribution of radioactive residues							
			MeOH		Water		Extracted radioactivity [b]		PES [c]	
			Mg eq/kg	% TRR	Mg eq/kg	% TRR	Mg eq/kg	% TRR	Mg eq/kg	% TRR
[difluorobenzamide-U-^{14}C]flufenoxuron										
Immature Leaves	15	2.673	2.551	95.4	0.022	0.8	2.573	96.2	0.100	3.7
Mature Leaves	29	1.819	1.763	96.6	0.011	0.6	1.774	97.2	0.045	2.5
Mature Fruit	29	0.014	0.014	95.8	< 0.0005	0.8	0.014	96.6	< 0.0005	3.4
Mature Stalks	29	0.163	0.17	96.3	0.001	0.5	0.158	96.8	0.005	3.2
[fluoroaniline-ring-U-^{14}C]flufenoxuron										
Immature Leaves	15	2.285	2.153	94.2	0.023	1.0	2.176	95.2	0.108	4.7
Mature Leaves	28	1.424	1.353	95.0	0.012	0.8	1.365	95.8	0.059	4.2
Mature Fruit	28	0.012	0.012	94.3	< 0.0005	0.8	0.012	95.1	0.001	4.9
Mature Stalks	28	0.106	0.100	94.5	0.001	0.8	0.101	95.3	0.005	4.7

[a] TRR = sum of extracted and unextracted radioactivity (PES)
[b] Methanol extract and water extract combined
[c] PES = post extraction solids (solids remaining after extraction)

Table 11 Summary of identified and characterized radioactivity extracted from [difluorobenzamide-U-^{14}C]-flufenoxuron -treated immature and mature leaves, grapes and stalks

Compound	Leaves (15 DAT)		Leaves (29 DAT)		Grapes (29 DAT)		Stalk (29 DAT	
	Mg eq/kg	%TRR	Mg eq/kg	%TRR	Mg eq/kg	%TRR	Mg eq/kg	%TRR
Flufenoxuron	2.305	86.2	1.763	96.9	0.007	49.7	0.157	96.3
Characterised [a]	0.269	9.9	0.011	0.6	0.006	46.9	0.001	0.5
Total extracted [b]	2.574	96.1	1.774	97.5	0.014	96.6	0.158	96.8
Total unextracted	0.100	3.7	0.045	2.5	< 0.001	3.4	0.005	3.2
Accountability [c]	2.674	99.8	1.819	100.0	0.014	100.0	0.163	100.0

[a] Total characterised consisted of polar unknowns, each accounting for <10% of the TRR and < 0.005 mg eq/kg
[b] Total extracted = MeOH and Aqueous extracts
[c] Accountability = (total extracted + total unextracted)/TRR

Table 12 Summary of identified and characterized radioactivity extracted from [U-Aniline-^{14}C]-flufenoxuron treated immature and mature leaves, grapes and stalks

Compound	Leaves (15 DAT)		Leaves (29 DAT)		Grapes (29 DAT)		Stalk (29 DAT)	
	Mg eq/kg	%TRR	Mg eq/kg	%TRR	Mg eq/kg	%TRR	Mg eq/kg	%TRR
Flufenoxuron	2.153	94.2	1.353	95.0	0.007	54.6	0.100	94.5
Characterised [a]	0.023	1.0	0.012	0.8	0.005	40.5	0.001	0.8
Total extracted [b]	2.176	95.2	1.365	95.8	0.012	95.1	0.101	95.3
Total unextracted	0.108	4.7	0.059	4.2	0.001	4.9	0.005	4.7
Accountability [c]	2.284	99.9	1.424	100.0	0.013	100.0	0.106	100.0

[a] Total characterised consisted of polar unknowns, each accounting for < 10% of the TRR and < 0.005 mg/kg
[b] Total extractable = MeOH and Aqueous extracts
[c] Accountability = (total extracted + total unextracted)/TRR

Apple

Flufenoxuron uniformly labelled in the fluoroaniline ring, formulated as a dispersible concentrate, was sprayed on 10 apple trees (var. Cox's Orange Pippin), maintained in glasshouses. The trees were treated during fruit development, when fruit was approximately 20 mm in diameter, with a single application at a rate of 0.1 kg ai/hL. Samples of immature fruit were harvested 0 days (4 h post-treatment) and 46 days after treatment (DAT), and mature fruit samples were collected at 99 DAT.

Immediately after harvest, all fruit samples (0, 46 and 99 DAT) were washed sequentially with acetonitrile (ACN) and hexane. Total radioactivity was determined in the washes and the fruit by combustion/LSC. At DAT 99 four additional apples were harvested; two of these were not washed and used for autoradiography while two other apples were washed as described above and separated into peel, pulp and seeds prior to analysis.

For the characterization/identification of residues, only the surface washes from the 0 and 99 DAT samples were prepared. Washed fruit samples were extracted three times with ACN:water (7:3, v/v) and centrifuged. The supernatants were combined and partitioned twice with dichloromethane (DCM). The DCM fraction was dried under a stream of nitrogen, and resuspended in DCM for TLC analysis. For HPLC-UV analysis, the DCM was removed under nitrogen and the residue was resuspended in ACN:water (7:3, v/v). The identity of parent flufenoxuron was confirmed by HPLC with a Polymeric Reversed Phase (PRP-1) column.

Total radioactive residues (TRRs) in immature fruit were 2.6 mg eq/kg (0 DAT) and declined to 0.16 mg eq/kg (46 DAT) and 0.06 mg eq/kg (99 DAT), likely due to the increasing size of the fruit as it matured (Table 13). The surface washes accounted for 77–96% of the TRRs with unextracted residues comprising 0.3–2.5% of the TRR (0.001–0.008 mg eq/kg), resulting in accountabilities of 93–100%. Parent flufenoxuron was the only compound identified in the surface washes (74–93% of

the TRRs; 0.043–2.4 mg eq/kg) and fruit extracts (3–16% of the TRRs; 0.01–0.08 mg eq/kg). There were no residues other than the parent that were identified in the apple samples.

For the two apples separated into peel, pulp and seeds and those subjected to autoradiography, the same trend was observed whereby the majority of the radioactivity remained on the peel with limited translocation of the TRRs into the pulp and the seeds.

Table 13 Total radioactive residues (TRR) in apples following a single foliar application of [^{14}C]-flufenoxuron at 100 mg ai/L

Matrix	DAT	TRR [a] (mg/kg)	Distribution of radioactive residues					
			Surface wash (ACN+ Hexane)		Fruit Extract		PES [b]	
			mg eq/kg	% TRR	mg eq/kg	% TRR	mg eq/kg	% TRR
Immature fruit	0	2.551	2.457	96.3	0.094	3.7	0.008	0.3
Immature fruit	46	0.163	0.146	89.4	0.017	10.6	0.000	0.0
Mature fruit	99	0.055	0.043	77.0	0.013	23.0	0.001	2.5

[a] TRR = sum of extracted and unextracted radioactivity (PES)
[b] PES = post extracted solids (solids remaining after extraction)

Table 14 Summary of characterization and identification of ^{14}C-residues in apple fruit following a single foliar application of [U-Aniline-^{14}C]-flufenoxuron at 100 mg ai/L

	Immature Fruit (0 DAT)		Mature Fruit (99 DAT)	
	mg eq/kg	%TRR	mg eq/kg	%TRR
Flufenoxuron	2.462	96.5	0.054	90.9
Total extracted [a]	2.551	100.0	0.054	90.9
Total unextracted	0.008	0.3	0.001	2.5
Accountability [b]	2.559	100.3	0.055	93.4

[a] Total extracted = surface wash + fruit extract
[b] Accountability = (total extracted + total unextracted)/TRR

Tomato

[U-Aniline-^{14}C]flufenoxuron mixed in approximately equal proportions with [aniline-^{15}N] and formulated as an emulsifiable concentrate, was applied as a single broadcast foliar application to tomato plants (var. Moneymaker) maintained in an outdoor uncovered enclosure. The application was made during fruit development at a rate of 0.125 kg ai/ha and tomato fruit was harvested at 0 and 28 days after treatment (DAT).

Tomato fruit samples were surface washed with ACN:water (7:3, v/v) five times prior to extraction. The washed fruit were homogenized and extracted once with ACN:water (7:3, v/v) and filtered. The surface washes and extracts were diluted with water and partitioned three times with DCM. The organic phase was concentrated, then analysed by thin-layer chromatography (TLC). Radioactivity in surface washes and extracts were determined by LSC while the unextracted solid residues were subjected to combustion analysis.

Total radioactive residue (TRR) in/on tomato fruit declined from 0.38 mg eq/kg on day 0, to 0.17–0.2 mg eq/kg by day 28 (Table 15). The total extracted residues (surface washes and fruit extracts) from 0 DAT to 28 DAT, accounted for 94–99% of the TRR (0.16–0.38 mg eq/kg), mainly from the surface wash (≥ 94% of the TRRs). Unextracted residues comprised 1.1–5.8% of the TRR (0.004–0.012 mg eq/kg). Only sample II (28 DAT; 0.2 mg eq/kg) underwent identification/characterization of TRRs. Radio- TLC of the extracted radioactivity showed the parent flufenoxuron as the only identified residue, accounting for 91% of the TRR (0.18 mg eq/kg).

Table 15 Total radioactive residues (TRR) in tomato fruit following a single application of [U-Aniline-^{14}C]-flufenoxuron at 0.125 kg ai/ha

Matrix	DAT	TRR [a] (mg eq/kg)	Distribution of radioactive residues					
			Surface wash (ACN+ Water)		Fruit Extract		PES [b]	
			mg eq/kg	% TRR	mg eq/kg	% TRR	mg eq/kg	% TRR
Tomato Sample	0	0.38	0.374	98.0	0.003	0.9	0.004	1.1
Tomato Sample I	28	0.17	0.160	95.4	0.001	0.5	0.007	4.1
Tomato Sample II	28	0.20	0.185	93.8	0.001	0.4	0.012	5.8

[a] TRR = sum of extracted and unextracted radioactivity (PES)
[b] PES = post extracted solids (total unextracted)

Table 16 Summary of characterization and identification of ^{14}C residues in tomato fruit following a single foliar application of [U-Aniline-^{14}C]-flufenoxuron at 0.125 kg ai/ha

Compound	Tomato Sample (0 DAT)		Tomato Sample I (28 DAT)		Tomato Sample II (28 DAT)	
	mg eq/kg	% TRR	mg eq/kg	% TRR	mg eq/kg	% TRR
Flufenoxuron	NR	NR	NR	NR	0.182	91.0
Total Extracted	0.376	98.9	0.164	95.9	0.188	94.2
Total Unextracted	0.004	1.1	0.007	4.1	0.012	5.8
Accountability [a]	0.380	100	0.171	100	0.200	100

NR = Not reported. Identification/Characterization of residues was only performed on the 28 DAT Tomato Sample II.
[a] Accountability = Total extracted + total unextracted

Chinese cabbage

[U-Aniline-^{14}C]flufenoxuron mixed in approximately equal proportions with [aniline-^{15}N] flufenoxuron, formulated as an emulsifiable concentrate, was applied as a single foliar application at a rate equivalent to 0.10 kg ai/ha to Chinese cabbage plants (grown outdoors) during leaf development. Cabbage plants were harvested at 0 and 28 days after treatment (DAT).

Samples of wrapper leaves were surface washed with ACN:water (7:3, v/v) five times prior to extraction. The washed leaves were homogenized, extracted (once for 0 DAT samples and twice for 28 DAT samples) with ACN:water (7:3, v/v) and filtered. The surface washes and extracts were diluted with water and partitioned three times with DCM. The organic phase was concentrated, then analysed by thin-layer chromatography (TLC). Radioactivity in surface washes and extracts were determined by LSC while the unextracted solid residues were subjected to combustion analysis.

Total radioactive residue (TRR) in/on cabbage wrapper leaves declined from 5.5–7.0 mg eq/kg (average 6.3 mg eq/kg) on day 0, to 0.33–0.36 mg eq/kg (average 0.35 mg eq/kg) by day 28. The total extracted residues (surface washes and extracts from the washed leaves) accounted for 94–97% of the TRR (0.32–6.8 mg eq/kg). However, at 0 DAT, the surface wash represented the majority of the extractable residues while at the 28 DAT, the leaf extracts accounted for much of the extractable radioactivity. Unextracted residues comprised 2.6–5.9% of the TRR (0.01–0.21 mg eq/kg). Only the 28-DAT sample (0.36 mg eq/kg) underwent identification/characterization of residues. Radio- TLC of the extracted radioactivity showed the parent flufenoxuron as the only identified residue, accounting for 93% of the TRR (0.34 mg eq/kg).

Table 17 Total radioactive residues (TRR) in Chinese cabbage leaves following a single foliar application of [U-Aniline-^{14}C]-flufenoxuron at 0.1 kg ai/ha

Matrix	DAT	TRR [a] (mg eq/kg)	Distribution of radioactive residues					
			Surface wash (ACN+ water)		Leaf Extract		PES [b]	
			mg eq/kg	% TRR	mg eq/kg	% TRR	mg eq/kg	% T2.8RR
Cabbage	0	6.3	5.3	84.0	0.8	13.2	0.2	2.8
Cabbage	28	0.35	0.07	18.9	0.27	75.9	0.01	5.2

All values reported as mean of replicate samples
[a] TRR = sum of extracted and unextracted radioactivity (PES)
[b] PES = post extracted solids (total unextracted)

Table 18 Summary of characterization and identification of ^{14}C residues in Chinese cabbage leaves following a single foliar application of [U-Aniline-^{14}C]-flufenoxuron at 0.1 kg ai/ha

Compound	Cabbage sample (0 DAT)		Cabbage sample (28 DAT)	
	mg eq/kg	% TRR	mg eq/kg	% TRR
Flufenoxuron	NR	NR		92.5
Total Extracted		97.2		94.8
PES		2.8		5.2
Accountability [a]		100		100

NR = Not reported. Identification/Characterization of residues was only performed on cabbage (28 DAT) sample.
[a] Accountability = Total extracted + PES

Overview of metabolic pathway in plants

The grape, apple, tomato and cabbage metabolism studies indicated that parent flufenoxuron was the only residue identified in all the tested primary crop matrices, and was found at > 90% of the TRR except grapes, where parent accounted for 50% of the TRR. No other metabolites were identified and no other residues were characterized (other than polar unknowns). The metabolism data (including autoradiography of the apple samples) indicated that the majority of radioactivity remained on the leaves or surface of the fruit, with limited translocation.

Environmental fate

The Meeting received information on, aerobic and anaerobic degradation in soil, photolysis on soil and pH based degradation. In conformance with the FAO manual 2009, only studies on aerobic degradation in soil were considered for the current evaluation. The fate and behaviour of flufenoxuron in the environment was investigated using amide-[U-^{14}C]-ring-labelled-flufenoxuron.

Study 1

The rate of aerobic degradation of flufenoxuron in three soils at a temperature of 20 °C was investigated [Goodyear and Gross, 2001, ENV 01-030]. Samples of test soils (50 g dry weight equivalent at 45% maximum water holding capacity (MWHC)), sieved to 2 mm were dispensed into flasks and treated with amide-[U-^{14}C]-ring-labelled-flufenoxuron at a nominal rate of 0.15 µg ai/g, corresponding to a field application rate of 150 g ai/ha. The treated soils were incubated in the dark at 20 ± 2 °C with moistened carbon dioxide free air drawn through the flasks for up to 120 hours. Volatiles in effluent air were trapped successively in ethanediol, 2% paraffin in xylene and 2 M sodium hydroxide. Samples were taken at 0, 2, 7, 14, 30, 59, 90 and 120 days after treatment (DAT). Trapping solutions were sampled and replaced on the same days.

Flufenoxuron was the only residue present at each sampling interval. The flufenoxuron concentration decreased steadily in all three soil types. At day 0, flufenoxuron represented > 99% TAR and decreased to 22–52% TAR after 120 days of incubation.

Table 19 Recovery of radioactivity and distribution of metabolites after application of amide-^{14}C-flufenoxuron to Chapel Hill Farm soil and incubation under aerobic conditions [%TAR]

Soil Name				SK 960087		
Source				Chapel Hill Farm, Empingham, Rutland, UK		
UK Particle Size Distribution Sand % (2000–63 µm) Silt % (63–2 µm) Clay % (< 2 µm) Textural Class				 33 35 32 Clay loam		
Organic carbon (%)				2.7		
Organic matter (%)				4.7		
pH in H_2O				8.0		
pH in 1 M KCl				7.2		
CEC (mEq/100 g)				19.6		
Water Holding Capacity pF0 (0.001 bar)%				56.6		
Water Holding Capacity pF2.5 (0.33 bar)%				25.0		
Microbial biomass (µg C/g) —start of study —end of study				 526.5 500.1		
Day	Flufenoxuron	Unresolved	CO_2	Other volatiles	Water soluble	Total % recovery
0	100.0	0.4	NA	NA	ND	102.7
2	95.1	0.7	0.3	ND	ND	99.4
7	91.1	0.3	1.4	ND	ND	97.6
14	89.5	ND	2.8	ND	ND	100.5
30	83.1	ND	5.5	ND	ND	97.9
59	70.2	0.3	10.1	ND	1.7	97.2
90	58.6	0.2	18.5	ND	2.3	98.6
120	51.6	0.4	23.2	ND	2.1	98.5

ND =Not detected
NA = Not applicable
CO_2 is the sum of the radioactivity in the 2M sodium hydroxide traps
Other volatiles is the sum of the radioactivity in the ethanediol and 2%paraffin in xylene traps

Table 20 Recovery of radioactivity and distribution of metabolites after application of amide-^{14}C-flufenoxuron to Newhaven soil and incubation under aerobic conditions [%TAR]

Soil Name				SK 15556090		
Source				Newhaven Cottage, Hartington Upper Quarter, Derbyshire, UK		
UK Particle Size Distribution Sand % (2000–63 µm) Silt % (63–2 µm) Clay % (< 2 µm) Textural Class				 23 57 20 Clay loam		
Organic carbon (%)				4.5		
Organic matter (%)				7.8		
pH in H_2O				6.7		
pH in 1 M KCl				6.2		
CEC (mEq/100 g)				17.4		
Water Holding Capacity pF0 (0.001 bar)%				107.7		
Water Holding Capacity pF2.5 (0.33 bar)%				48.5		
Microbial biomass (µg C/g) —start of study —end of study				 604.8 654.1		
Day	Flufenoxuron	Unresolved	CO_2	Other volatiles	Water soluble	Total %recovery
0	101.0	0.5	NA	NA	ND	103.2
2	96.5	0.7	1.4	ND	ND	101.9
7	85.6	0.3	5.4	ND	1.1	100.8
14	69.1	ND	13.3	ND	0.6	97.1
30	56.2	0.1	21.9	ND	1.5	97.4

Soil Name				SK 15556090		
Source				Newhaven Cottage, Hartington Upper Quarter, Derbyshire, UK		
59	37.6	0.2	34.7	ND	1.8	98.4
90	24.7	0.1	46.0	ND	2.2	99.5
120	22.0	0.1	52.5	ND	1.9	101.6

ND =Not detected
NA = Not applicable
CO_2 is the sum of the radioactivity in the 2 M sodium hydroxide traps
Other volatiles is the sum of the radioactivity in the ethanediol and 2%paraffin in xylene traps

Table 21 Recovery of radioactivity and distribution of metabolites after application of Amide-^{14}C-flufenoxuron to Baylam soil and incubation under aerobic conditions [%TAR]

Soil Name				PT 103		
Source				Baylam, Ipswich, Suffolk, UK		
UK Particle Size Distribution Sand % (2000–63 µm) Silt % (63–2 µm) Clay % (< 2 µm) Textural Class				 71 14 15 Sandy loam		
Organic carbon (%)				1.4		
Organic matter (%)				2.4		
pH in H_2O				5.5		
pH in 1 M KCl				4.9		
CEC (mEq/100 g)				8.3		
Water Holding Capacity pF0 (0.001 bar)%				47.6		
Water Holding Capacity pF2.5 (0.33 bar)%				16.2		
Microbial biomass (µg C/g) —start of study —end of study				 434.9 226.1		
Day	Flufenoxuron	Unresolved	CO_2	Other volatiles	Water soluble	Total %recovery
0	99.1	0.5	NA	NA	ND	100.6
2	96.2	0.7	1.2	ND	ND	101.8
7	82.1	0.2	6.1	ND	0.8	98.4
14	73.4	0.2	10.8	ND	0.7	98.1
30	60.3	0.2	19.5	ND	1.5	100.2
59	50.5	0.2	24.3	ND	1.8	96.4
90	46.8	0.3	30.1	ND	1.5	98.7
120	38.3	0.1	36.4	ND	ND	97.4

ND =Not detected
NA = Not applicable
CO_2 is the sum of the radioactivity in the 2M sodium hydroxide traps
Other volatiles is the sum of the radioactivity in the ethanediol and 2% paraffin in xylene traps

Table 22 Dissipation times of flufenoxuron

Parameter	SK 960087	SK 15556090	PT 103
DT_{50} (days)	124	36	64
DT_{90} (days)	432	191	449
R2 (correlation coefficient)	0.998	0.997	0.997

Study 2

The aerobic degradation rate of 2-fluoroaniline-[U-^{14}C]-ring-labelled-flufenoxuron was investigated in two types of soils, while the degradation of the flufenoxuron-derived soil metabolite, ^{14}C-Reg. No. 4064702, was investigated in four different soils [Stephen and Ebert, 2003, 83303]. Samples of test soils (40% MWHC) were dispensed into glass bottles, treated at a nominal rate of 0.05 mg ai/kg,

corresponding to a field application rate of 40 g ai/ha, and incubated in the dark at 20 ± 2 ºC. Samples were taken at 0, 3, 7, 14, 30, 57, 91 and 119 days after treatment (DAT).

Table 23 Soil characteristics

Soil Name	Bruch West	Li35B	LUFA2.2	LUFA 3.
Particle Size (Pipette method) (%)				
2000 to ≥ 1000 µm	0.2	1.0	0.5	0.5
1000 to ≥ 500 µm	2.7	6.5	2.3	2.1
500 to ≥ 250 µm	16.3	29.6	25.4	5.2
250 to ≥ 100 µm	39.0	30.0	45.6	26.8
100 to ≥ 50 µm	17.8	8.6	6.7	22.1
50 to ≥ 2µm	23.1	17.0	1504	37.9
< 2 µm	0.8	7.4	4.1	5.4
Textural Class	Loamy sand	Loamy Sand	Loamy sand	Sandy loam
TOC (Coulometric titration) (%)	2.29	0.89	2.38	2.38
TC (Coulometric titration) (%)	3.90	0.90	2.38	4.00
pH in H_2O	7.0	7.1	6.6	8.1
pH in CaCl	7.8	6.3	5.9	7.4
CEC (mval Ba/100 g dry weight)	14.0	7.4	9.7	19.6
Water Holding Capacity (g/100 g dry weight)	30.4	27.7	39.4	42.8
Total Nitrogen (%)	0.16	0.10	0.19	0.22
Ammonium-N (Ion chromatography) (mg/100 g dry weight)	0.3	0.3	0.5	0.4
Nitrate-N (Ion chromatography) (mg/100 g dry weight)	0.20	0.10	0.09	1.8
Microbial biomass (OxiTop method) (mg C/100 g dry weight)	30.2	16.2	36.1	67.8
Ratio Microbial biomass / TOC (calculated) (%)	1.3	1.8	1.5	2.8

The amounts of extractable residues, in both soils treated with radiolabelled flufenoxuron, decreased to ≤ 50% of the total applied radioactivity while the bound residues increased to 38.8–43.8% TAR. No formation of CO_2 was noted. Following treatment of four soils with the metabolite Reg. No. 4064702, less than 25.5% TAR was extractable after 119 days of incubation. The bound residues reached levels of 65–80% TAR at the end of the incubation period. In two of the soils, slow mineralization was observed, reaching 2–8%TAR at the end of incubation while in the other two soils, there was no evidence of CO_2 evolution.

When treated with radiolabelled flufenoxuron, the metabolite Reg. No. 4064702, representing the fluoroaniline moiety after cleavage of the flufenoxuron molecule, was identified by chromatographic comparison with the ^{14}C-labelled reference compound. The highest concentration of this metabolite was reached after 30 days of incubation, accounting for 4.1–8.3% TAR. Flufenoxuron decreased to 45.8–51.0% TAR in the soil after 119 days. While other peaks could be observed in the chromatograms at 119 DAT, all were below the limit of quantification (0.001 mg/kg). The DT_{50} was calculated to be in the range of 115–122 days (Table 24).

In all four tested soils treated with Reg. No. 4064702, the metabolite degraded relatively quickly reaching < 50% TAR after 57 days of incubation and 16–24% TAR after 119 days. According to the chromatograms of the extracts from sampling days 57, 91 and 119, two degradation products were detected and present at concentrations close to the LOQ. One of these appeared to be the metabolite Reg. No. 241208, DT_{50} values were in the range of 47–59 days (Table 24).

Table 24 Dissipation times of flufenoxuron and the metabolite Reg. No. 4064702

Analyte	Soil	DT_{50} (days)	DT_{90} (days)
Flufenoxuron [a]	Bruch West	122	407
	Li35B	115	381
Reg. No. 4064702 [b]	Bruch West	57	190
	Li35B	56	186
	LUFA 2.2	59	196
	LUFA 3A	47	156

[a] Degradation rates obtained using a 2 compartment model
[b] Degradation rates obtained using a 3 compartment model

Based on the findings of the soil aerobic degradation studies, the DT_{50} of flufenoxuron and the metabolite Reg. No. 4064702 were 124 days and 57 days, respectively, demonstrating persistence of the parent in soil yet limited persistence of the metabolite.

Residues in Rotational Crops

Neither confined crop rotation or field accumulation studies were submitted.

METHODS OF RESIDUE ANALYSIS

Analytical methods

The meeting received analytical method descriptions and validation data for flufenoxuron in plant and animal commodities and in soil and water. For the majority of the methods, residues of flufenoxuron are measured by HPLC-MS/MS with two specific mass transitions or with HPLC-UV at 254–260 nm for each analyte. All methods were validated at the determined LOQs, ranging from 0.01–0.05 mg/kg depending on the matrix. A summary of the analytical methods for plant and animal commodities and environmental media is provided below.

The applicability of the DFG S19 multi residue method was investigated using animal matrices (milk, meat, eggs), however, the results did not confirm sufficient applicability.

A number of scientific papers report the validation of the QuEChERS multiresidue method using GC-MS/MS for flufenoxuron in various plant commodities.

Table 25 Overview of flufenoxuron analytical methods for plant matrices

Method	Matrix	Analyte(s)	Extraction	Clean-up	Detection, LOQ	Reference
Enforcement method						
RLA 12675	Grapes, lettuce, tomatoes and tomato processing commodities	Flufenoxuron	DCM	Liquid/liquid partitioning with water/cyclohexane or aqueous acidic methanol/ cyclohexane.	HPLC-MS/MS 0.05 mg/kg	2003/1004358
	Grapes, tomatoes, wheat grain, wheat forage, wheat straw and rape seed	Flufenoxuron	DCM	Liquid/liquid partitioning with water/cyclohexane.	HPLC-MS/MS 0.05 mg/kg	2004/1000759 Independent laboratory validation
	Orange and melon	Flufenoxuron	DCM	Liquid/liquid partitioning with water/cyclohexane.	HPLC-MS/MS 0.05 mg/kg	2008/7012012 Independent laboratory validation
Data generation methods						

P1907-G	Apple, citrus, soya bean, wheat grain	Flufenoxuron CL 359882, CL 932338, CL 211558	methanol, water and HCl		HPLC-MS/MS 0.01 mg/kg	2010/1051669
Not specified	Tea Leaves	Flufenoxuron	Aqueous acetone	Liquid/liquid partitioning with hexane followed by ACN.	HPLC-UV 0.8 mg/kg	FX-790-025
Not specified	Infused tea	Flufenoxuron	Precipitation with acetone and lead acetate	Liquid/liquid partitioning with hexane.	HPLC-UV 0.8 mg/kg	FX-790-026
P1340G	Green tea	Flufenoxuron, CL 932338, CL 211558, CL 359882	Methanol/ water/HCl		HPLC-MS/MS 0.01 mg/kg	2007/300204
	Green tea	Flufenoxuron	Methanol/ water/HCl		HPLC-MS/MS 0.1 mg/kg	2008/1042807 Independent laboratory validation

Table 26 Overview of flufenoxuron analytical methods for animal matrices

Method	Matrix	Analyte(s)	Extraction	Clean-up	Detection, LOQ	Reference
Enforcement methods						
SAMS 458-1	Fat	Flufenoxuron	Warm acetone/hexane (20:80 v/v) and sodium sulphate	Partitioning with ACN and clean-up by RP HPLC.	HPLC-UV 0.01 mg/kg	FX-245-003
	Fat	Flufenoxuron	Methylene chloride and sodium sulphate	Clean-up by SPE and RP HPLC.	HPLC-UV 0.05 mg/kg	FX-245-009 Independent laboratory validation
SAMS 486-1	Milk	Flufenoxuron	Diethyl ether and hexane	Partitioning with ACN followed by clean up with NP HPLC.	HPLC-UV 0.1 µg/L	FX-245-004
	Milk	Flufenoxuron	Potassium oxalate and ethanol followed by diethyl ether and hexane	Partitioning with ACN followed by clean up with NP HPLC.	HPLC-UV 0.01 mg/kg	FX-245-008 Independent laboratory validation
Data generation methods						
DFG S 19	Milk, meat, eggs	Flufenoxuron	Aqueous acetone		HPLC-MS/MS 0.01 mg/kg	2002/5004112 (not sufficiently validated)
SAMS 457-2	Fat, whole blood, muscle, kidney, liver, bone marrow	Flufenoxuron	Sodium sulfate, hexane and ACN	Liquid/liquid partitioning and clean-up by NP or RP HPLC	HPLC-UV 0.03 mg/kg	FX-245-002 (1989/7000985)
SAMS 457-1	Liver	Flufenoxuron	Acetone/hexane (20:80 v/v) and sodium sulphate	Partitioning with water/ACN (20:80 v/v).	HPLC-UV LOQ not reported	FX-245-010
Not specified	Blood	Flufenoxuron	Warm acetone	Partitioning with hexane.	HPLC-UV LOQ not reported	FX-245-006
SAMS 492-1	Eggs	Flufenoxuron	Boiling acetone and hexane	Partitioning with ACN followed by clean-up with	HPLC-UV 0.01 mg/kg	FX-245-005

				NP HPLC.		
01791.PCC	Liver of poultry	REG. NO. 4064702	Acetonitrile	Partitioning with n-hexane and clean-up by RP semi-preparative HPLC	HPLC-UV 0.03 mg/kg	FX-705-006

Plant materials

Method RLA 12675 involves extraction of flufenoxuron residues from finely chopped fruit with dichloromethane. An aliquot of the extract is evaporated to dryness, reconstituted in cyclohexane, and then partitioned with water. An aliquot of the cyclohexane phase is taken, evaporated to dryness, reconstituted in acetonitrile:methanol:water (58:10:32, v/v/v), and analysed by LC-MS/MS using the positive ionization mode monitoring ion transitions *m/z* 498→158 (for quantitation) and *m/z* 498→141 (for confirmatory purposes).

The applicability of the method was confirmed in an independent laboratory by Schulz (2004, 2004/1000759) and Saha (2008, 2008/7012012). In both laboratories, parent flufenoxuron was analysed with a validated LOQ of 0.05 mg/kg (Table 27).

Table 27 Independent laboratory recovery results for method RLA 12675

Matrix	Fortification level [mg/kg]	No. of tests	Range of Recoveries [%]	Mean Recovery [%]	SD
Tomato	0.05	5	78–92	83	5.7
	0.5	5	78–88	82	4.3
Grapes	0.05	5	86–98	90	4.8
	0.5	5	87–93	90	2.7
Wheat grain	0.05	5	84–92	87	2.9
	0.5	5	79–87	83	3.2
Wheat forage	0.05	5	81–85	83	1.8
	0.5	5	84–89	86	1.8
Wheat straw	0.05	5	75–83	78	3.2
	0.5	5	78–89	83	3.9
Rape seed	0.05	5	80–90	88	5.8
	0.5	5	87–97	93	3.8
Orange fruit	0.05	5	69–81	74	5
	0.5	5	73–86	81	6
Melon fruit	0.05	5	82–93	85	5
	0.5	5	82–95	89	5

Tea

An independent laboratory method validation was conducted by Marin, (2008, 2008/1042807) to determine the validity of the procedure P 1340G to analyse flufenoxuron in tea (green).

Table 28 Independent laboratory recovery results of method P 1340G

Matrix	No. of tests	Fortification level [mg/kg]	Transition (m/z= 489 → 158) [a]			Transition (m/z= 489 → 141)		
			Range of Recoveries[%]	mean [%]	SD [+/–]	Range of Recoveries [%]	mean [%]	SD [+/–]
Tea (green)	5	0.1	65–81	75	7	63–80	72	7
	5	10	76–88	80	5	73–85	78	4

[a] Used for quantitation

Animal materials

Method SAMS 486-1 involves treating a sample of milk with potassium oxalate solution and ethanol followed by extraction with diethyl ether and hexane. The diethyl ether is removed by evaporation and the hexane is partitioned with acetonitrile. The acetonitrile is exchanged for a mixture of hexane, ethanol and acetic acid and cleaned-up by normal phase HPLC. Residues of flufenoxuron are determined by reverse-phase HPLC with UV detection at 254 nm.

The applicability of the method was confirmed by an independent laboratory by Skorczynski (1997, RES 97-027) where parent flufenoxuron was analysed with a validated LOQ of 0.01 mg/kg (Table 29).

Table 29 Independent laboratory recovery results of method SAMS 486-1

Matrix	Fortification level [mg/kg]	No. of tests	Range of Recoveries [%]	Mean Recovery [%]
Milk	0.01	2	84–85	85
	0.02	2	89–110	100

Method SAMS 458-1, involves extracting residues of flufenoxuron in fat with methylene chloride and sodium sulphate, followed by evaporation to dryness, then re-dissolving the residue in hexane followed by solid-phase extraction clean-up and reversed-phase HPLC-clean-up. Determination of residues of flufenoxuron is performed by normal-phase HPLC with UV-detection at 254 nm.

The applicability of the method was confirmed in an independent laboratory by Skorczynski (1997, RES 97-037) where parent flufenoxuron was analysed with a validated LOQ of 0.05 mg/kg (Table 30).

Table 30 Independent laboratory recovery results of method SAMS 458-1

Matrix	Fortification level [mg/kg]	No. of tests	Range of Recoveries[%]	Mean Recovery [%]
Beef fat	0.05	2	75–93	84
	0.1	2	77–81	79

STABILITY OF PESTICIDES IN STORED SAMPLES

Plant materials

The storage stability of flufenoxuron has been investigated in various plant matrices for a storage period of up to 36 months.

The storage stability of flufenoxuron was investigated in cottonseed, orange, grape and apple for up to 36 months (Gillard, D.F., 1993a, FX-326-004), in lettuce for 27 months (Edwards, 2000?a, 2000/1021958; Farell, 1996a, FX-726-003) and in watermelon peel and pulp for 25–26 months (Edwards, 2000b, 2000/1021961; Edwards, 2000c, 2000/1021962).

Homogenised samples were weighed into glass jars and fortified individually at levels of 0.1 mg/kg (cottonseed, orange, grape and apple) and 0.5 mg/kg (lettuce, watermelon peel and pulp). After fortification, the solvent was allowed to evaporate. In addition, untreated samples of each sample material were prepared for control and recovery experiments. Subsequently the jars were closed and stored deep frozen until analysis (except for the day 0 samples). At each sampling interval, 2–3 fortified and two control samples were removed from the deep-freezer. Subsequently, one of the control samples of each sample material was freshly fortified with flufenoxuron to determine the concurrent recoveries. Fortification levels were at the same magnitude as the spiked storage samples.

The grape and apple samples were analysed according to the Analytical Method SAMS 423-3. Briefly, flufenoxuron is extracted from the samples by blending with methylene chloride and sodium sulfate. An aliquot of the extract was concentrated to dryness and cleaned up by solid phase extraction prior to HPLC analysis.

The cottonseed and orange samples were analysed according to the Analytical Method SAMS 454-1 where flufenoxuron was extracted by blending with acetone:hexane (v:v) and sodium sulphate. An aliquot of the extract was concentrated to dryness, reconstituted in acetonitrile and partitioned with hexane. The acetonitrile phase was cleaned up by solid phase extraction prior to HPLC analysis.

Lettuce samples were analysed using Analytical Method RLA 12466.00V while watermelon peel and pulp samples were analysed using Analytical Method RLA 12482.00V. No description was provided of either method.

No significant degradation of the flufenoxuron residues was observed in cottonseed, orange, grape and apple up to 36 months of storage, in lettuce for 27 months and watermelon (pulp and peel) for up to 26 months (Table 31).

Table 31 Storage stability of flufenoxuron in plant commodities fortified with flufenoxuron at 0.1 mg/kg

Matrix	Storage Period (months)	Residue levels in stored samples [a] (%)			Procedural recoveries [a] (%)
		Individual Values	Mean	RSD (%)	Individual Values
Cottonseed	0	126.0, 125.8, 132.0	128	2.8	125.2
	3	107.8, 87.0	98	–	97.4
	6	92.0, 95.0, 81.0	89	8.2	80.0
	12	123.2, 113.2, 130.0	122	6.9	126.4
	14	–	–	–	–
	18	100.8, 104.0, 113.5	106	6.2	121.2
	24	91.2, 104.4, 86.8	94	9.7	110.4
	36	84.2, 79.8, 77.0	80	4.5	81.0
Orange	0	93.2, 112.0, 111.2	105	10.1	116.8
	4	102.8, 114.8, 110.4	109	5.6	119.6
	6	113.2, 113.2, 118.4	115	2.6	116.0
	12	–	–	–	–
	14	126.8, 105.6	117	–	112.8
	18	106.0, 115.4, 120.0	114	6.3	106.6
	24	95.0, 90.8, 84.8	91	5.7	89.6
	36	85.2, 97.2, 87.6	90	7.1	97.6
Grape	0	109.0, 114.0, 109.0	111	2.6	115.0
	3	120.0, 128.5, 106.5	119	9.4	107.0
	6	105.0, 107.0, 106.0	106	0.9	101.0
	12	–	–	–	–
	14	110.0, 109.5	110	–	128.5
	18	119.5, 127.0, 127.0	125	3.5	127.5
	24	116.0, 118.5, 128.5	121	5.5	94.5
	36	81.5, 93.0, 111.0	95	15.6	89.5
Apple	0	105.5, 98.5	103	–	101.5
	3	119.5, 115.0	118	–	98.0
	6	104.0, 106.5, 121.0	111	8.3	95.5
	12	–	–	–	–
	14	114.0, 124.0	119	–	121.0
	18	129.0, 123.5, 127.5	126	2.2	111.0
	24	79.0, 98.0, 104.5	94	14.1	88.5
	36	110.8, 109.4, 105.8	109	2.4	103.5
Lettuce	0	108, 107	108	–	110
	1	94, 93	94	–	106
	3	74, 96	85	–	98

Matrix	Storage Period (months)	Residue levels in stored samples [a] (%)			Procedural recoveries [a] (%)
		Individual Values	Mean	RSD (%)	Individual Values
	14	89, 85	87	–	104
	18	96, 87	92	–	88
	27	87, 85	86	–	90
Watermelon peel	0	108, 107	108	–	107
	1	101, 92	97	–	107
	3	88, 85	87	–	92
	14	106, 102	104	–	109
	18	83, 85	84	–	89
	26	69, 80	75	–	101
Watermelon pulp	0	109, 108	109	–	109
	1	104, 102	103	–	110
	3	105, 97	101	–	109
	14	99, 97	98	–	98
	18	88, 89	89	–	95
	26	79, 92	86	–	78

[a] Reported as a function of the nominal (0.1 mg/kg) spiking level

Animal Materials

For animal matrices, the storage stability of flufenoxuron has been investigated for a storage period of up to 12 months (Lewis 1993a, FX-326-003).

The freezer stability of flufenoxuron in various animal matrices was investigated over a period of one year (53 weeks). Untreated bovine muscle, liver, kidney, fat and milk and hen skin, egg yolk and egg white samples were fortified with radiolabelled flufenoxuron at three different concentrations. The samples were stored at -19 °C. All beef and hen skin samples were analysed according to the Analytical Method SAMS 457-2 with a slight modification for extracting heparin-treated blood. Egg yolk and egg white samples were analysed according to the Analytical Method SAMS 492-1. Cow's milk samples were analysed based on the Analytical Method SAMS 486-1. Residues were analysed by TLC, HPLC-UV and LSC.

No significant degradation of the flufenoxuron residues was observed in any of the animal matrices except egg whites where a steady decline was noted by 53 weeks (31% dissipation).

Table 32 Storage stability of flufenoxuron in animal commodities

Commodity	Fortification Level (mg/kg)	Recoveries in stored samples [a] (%) Duration (weeks)				
		0	4	13	26	53
Bovine muscle	0.107	83	61	67	62	61
	1.09	84	62	72	63	66
	11.3	83	63	67	63	68
Bovine liver	0.108	87	75	79	76	84
	1.08	83	73	71	79	88
	10.9	89	75	85	83	87
Bovine kidney	0.108	88	79		70	77
	1.10	89	73	–	76	78
	11.3	88	72		77	81
Bovine fat	0.106	98	103	92	94	92
	1.04	98	104	95	99	90
	10.9	97	102	92	94	91
Cow's milk	0.0556	88	86	85	90	87
	0.56	91	90	80	78	89
	5.91	88	88	84	84	86
Bovine blood	0.0547	82	80	67	68	83
	0.578	79	77	68	65	84
	5.94	79	81	72	71	84

Commodity	Fortification Level (mg/kg)	Recoveries in stored samples [a] (%) Duration (weeks)				
		0	4	13	26	53
Hen skin	0.109	97	95		85	92
	1.11	96	92	–	80	90
	11.5	96	90		89	89
Egg yolk	0.109	95	94		83	89
	1.09	92	94	–	89	87
	11.8	89	87		81	82
Egg white	0.110	96	NA	62	70	65
	1.14	93	81	63	80	64
	11.6	94	82	71	66	76

[a] Reported as total percent applied radioactivity, are a function of the specified fortification level.

USE PATTERN

Flufenoxuron is a new benzoylurea type of acaricide/insecticide which inhibits chitin biosynthesis in nymphal mites and caterpillars. Flufenoxuron is registered in Brazil and in Japan as an emulsifiable concentrate (EC).

The Meeting received the registered label from Brazil for orange, apple and from Japan for tea in the original languages as well as the English translations.

Table 33 List of uses of flufenoxuron

Crop	Country	Application			Application rate per treatment			PHI [days]
		Method	No. per season	Application interval [days]	kg ai/hL	Water L/ha	kg ai/ha	
Orange	Brazil	spray	2	30	0.003–0.005	–	–	15
Apple	Brazil	spray	–	–	0.01	1200–2000		35
Tea	Japan	spray	2	7–14	0.0025	2000–4000	0.05–0.1	7

RESIDUES RESULTING FROM SUPERVISED TRIALS ON CROPS

Residue levels were reported as measured. Application rates were always reported as flufenoxuron equivalents. When residues were not quantifiable they are shown as below the LOQ, e.g., < 0.01 mg/kg.

Application rates and spray concentrations have generally been rounded to two significant figures.

All samples were analysed using either an HPLC-UV method (254 nm) which involved extraction with DCM and sodium sulphate and a validated LOQ of 0.05 mg/kg or an HPLC/MS/MS method involving extraction with methanol/water/HCl and partitioning in water cyclohexane with an LOQ of 0.01 mg/kg.

Laboratory reports included method validation including batch recoveries at fortification levels bracketing the LOQ, 10× LOQ and 100× LOQ. Dates of analyses or duration of residue sample storage were also provided. These storage intervals were covered by the storage stability studies on parent in high oil, high acid and high water content matrices.

Field reports provided data on the sprayers used and their calibration, plot size, residue sample size and sampling date. Although trials included control plots, no control data are recorded in the tables as residues in control samples were below the method LOQ. Residue data are recorded unadjusted for % recovery. Where multiple samples were taken from a single plot or where multiple analyses were conducted for the same sample, the average value is reported, with the individual

values captured in brackets. Residues from trials conducted according to critical GAP are underlined and have been used for the estimation of maximum residue levels, STMR and HR values.

Crop	Field/Greenhouse	Treatment Type	Countries	Table
Orange	Field	Foliar spray	Brazil, Greece, Italy, South Africa	34
Apple	Field	Foliar spray	Chile	35
Tea	Field	Foliar spray	Japan	36

Oranges

Eleven supervised residue trials were conducted during 1986, 2007 and 2011 on oranges grown in Brazil and treated once or twice with a soluble concentrate (SL) or dispersible concentrate (DC) formulation of flufenoxuron at rates of 0.003–0.005 kg ai/hL. Oranges were harvested 0–28 days following the last application. In the 1986 trials, residues are reported in peel and pulp based on ratios of 37% peel and 63%pulp. For the remaining trials, the residues are reported on a whole fruit basis.

Five additional orange trials, involving application of a DC formulation, were also conducted in Greece (two; 1996), Italy (one, 1996) and South Africa (two; 1989). The number of applications and treatment rates for Greece, Italy and South Africa were 2× 0.005 kg ai/hL, 2× 0.008 kg ai/hL and 1× 0.005 kg ai/hL, respectively. Oranges were harvested 0–28 days following the last application and separated into peel and pulp prior to analysis.

Table 34 Residues of flufenoxuron in oranges following foliar spray with SL or DC formulations

Trial location, Country, Year (Variety)	Application					Growth Stage	DAT, days	Matrix	Flufenoxuron Residues [a] (mg/kg)	Ref
	Form	kg ai/ha	kg ai/hL	no.	RTI, days					
cGap Brazil	100 g/L		0.003–0.005	2	30		15			
Mogi-Mirim-SP, Brazil, 1986 (Pera Coroa)	SL 50 g/L	0.04	0.003	1	NA	Ripening	3 3 3 7 7 7 15 15 15	Peel Pulp Whole fruit [b] Peel Pulp Whole fruit [b] Peel Pulp Whole fruit [b]	0.11 < 0.02 0.05 0.05 < 0.02 0.03 0.06 < 0.02 0.03	I/BER/RE/CI-01185
Mogi-Mirim-SP, Brazil, 1986 (Pera Coroa)	SL 50 g/L	0.04	0.005	1	NA	Ripening	3 3 3 7 7 7 15 15 15	Peel Pulp Whole fruit [b] Peel Pulp Whole fruit [b] Peel Pulp Whole fruit [b]	0.2 < 0.02 0.09 0.2 < 0.02 0.09 0.2 < 0.02 0.09	I/BER/RE/CI-01185
Palea Korinthos, Greece, 1996 (Navalline)	DC	0.08–0.11	0.005	2	151	BBCH 85–89	14 14 14 28 28 28	Peel Pulp Whole fruit [c] Peel Pulp	0.23 < 0.05 0.11 0.27 < 0.05 0.13	96-651-01

Trial location, Country, Year (Variety)	Application					Growth Stage	DAT, days	Matrix	Flufenoxuron Residues [a] (mg/kg)	Ref
	Form	kg ai/ha	kg ai/hL	no.	RTI, days					
								Whole fruit[2)]		
Drosia Chalkidas,, Greece, 1996 (Navalline)	DC	0.07–0.11	0.005	2	153	BBCH 85–89	14 14 14 28 28 28	Peel Pulp Whole fruit [c] Peel Pulp Whole fruit [c]	0.61 < 0.05 0.25 0.43 < 0.05 0.31	96-651-02
Castellanita Marina, Italy, 1996 (Navalin)	DC 50 g/L	0.07	0.008	2	14	BBCH 85–87	0 0 0	Peel Pulp Whole fruit [b]	0.33 < 0.05 0.15	96-556-01
							7 7 7	Peel Pulp Whole fruit [b]	0.36 < 0.05 0.16	
							14 14 14	Peel Pulp Whole fruit [b]	0.28 < 0.05 0.14	
							21 21 21	Peel Pulp Whole fruit [b]	0.31 < 0.05 0.15	
							28 28 28	Peel Pulp Whole fruit [c]	0.16 < 0.05 0.09	
South Africa, 1989 (Navel)	DC	NS	0.003	1	NA	Ripening	0 0 0 7 7 7 13 13 13 28 28 28	Peel Pulp Whole fruit [c] Peel Pulp Whole fruit [c] Peel Pulp Whole fruit [c] Peel Pulp Whole fruit [c]	0.26 0.01 0.04 0.24 < 0.01 0.07 0.45 < 0.01 0.10 0.33 < 0.01 0.08	FX-710-005
South Africa, 1989 (Navel)	DC	NS	0.005	1	NA	Ripening	0 0 0 7 7 7 13 13 13 28 28 28	Peel Pulp Whole fruit [c] Peel Pulp Whole fruit [c] Peel Pulp Whole fruit [c] Peel Pulp Whole	0.43 0.01 0.13 0.51 < 0.01 0.15 0.46 < 0.01 0.09 0.48 < 0.01 0.12	FX-710-005

Trial location, Country, Year (Variety)	Application					Growth Stage	DAT, days	Matrix	Flufenoxuron Residues [a] (mg/kg)	Ref
	Form	kg ai/ha	kg ai/hL	no.	RTI, days					
								fruit [c]		
Santo Antonio de Posse, Brazil, 2007 (Pera)	DC	0.06	0.003	2	NS	BBCH 88	0 5 10 15 20	Whole fruit	0.05 (0.05, 0.05) 0.06 (0.06, 0.06) 0.05 (0.04, 0.05) 0.07 (0.05, 0.04 0.09, 0.07) 0.06 (0.05, 0.06)	EC-CD-BRUA/1100-06
Uberlandia, Brazil, 2007 (Natal)	DC	0.06	0.003	2	NS	BBCH 83	0 6 10 15 20	Whole fruit	0.12 (0.11, 0.12) 0.10 (0.10, 0.10) 0.11 (0.10, 0.11) 0.10 (0.09, 0.10) 0.07 (0.07, 0.06)	EC-CD-BRVA/1100-06
Pirassununga, Brazil, 2007 (Valência)	DC	0.06	0.003	2	NS	BBCH 87	15	Whole fruit	0.05 (0.05, 0.04)	EC-R-BRUB/1100-06
Estiva Gerbi, Brazil, 2007 (Valência)	DC	0.06	0.003	2	NS	BBCH 88	15	Whole fruit	0.08 (0.09, 0.06)	EC-R-BRUC/1100-06
Santo Antonio de Posse, Brazil, 2011 (Natal)	DC	0.10	0.005	2	30 [d]	BBCH 87	0 7 15 21	Whole fruit	0.13 (0.16, 0.13, 0.12, 0.12) 0.14 (0.18, 0.14, 0.13, 0.13) <u>0.13</u> (0.13, 0.13, 0.13, 0.12) 0.12 (0.15, 0.10, 0.10, 0.11)	G100555
Sao Sebastiao, da Amoreira, Brazil, 2011 (Navelina)	DC	0.10	0.005	2	30 [d]	BBCH 81	15	Whole fruit	<u>0.09</u>	G100557
Tamarana, Brazil, 2011 (Folha murcha)	DC	0.10	0.005	2	30 [d]	BBCH 85	15	Whole fruit	<u>0.16</u> (0.20, 0.14, 0.14, 0.15)	G100631
Jaboticabal, Brazil, 2011 (Pera)	DC	0.08	0.002	2	30 [d]	BBCH 83	0 7 15 20	Whole fruit	0.05 0.02 0.03 < 0.01	G100697
Jaboticabal, Brazil, 2011 (Pera)	DC	0.10	0.005	2	30 [d]	BBCH 81	0 7 15 21	Whole fruit	0.13 0.10 <u>0.11</u> 0.10	G100737

SL: Soluble concentrate
DC: Dispersible concentrate
[a] When there are 2 residues per PHI, the replicate samples from the same plot where there are 4 residues per PHI, these represent four replicate samples from two plots.

[b] Calculated using a ratio of 37% peel and 63% pulp
[c] Calculated using the exact peel and pulp samples
[d] Determined based on dates of application

Apples

Fourteen supervised residue trials were conducted in Chile during the 1988–1990 growing seasons on apples treated once, early season, with flufenoxuron at rates of 0.01–0.02 kg ai/hL and harvested 35–150 days following application.

Table 35 Residues of flufenoxuron in apples following foliar spray

Trial location, Country, Year (Variety)	Application					Growth Stage	DAT, days	Flufenoxuron Residues (mg/kg)	Ref
	Form	kg ai/ha	kg ai/hL	Water, L/ha	no.				
cGap Brazil	100 g/L		0.01	1200–2000	1		35		
San Fernando, Chile, 1988 (variety not specified)	NS	0.22	0.01	2200	1	prior to bloom	35	0.45	UCH-SF
							77	< 0.05	
							113	< 0.05	
							126	< 0.05	
	NS	0.33	0.015	2200	1	prior to bloom	35	0.52	
							77	< 0.05	
							113	< 0.05	
							126	< 0.05	
	NS	0.44	0.02	2200	1	prior to bloom	35	0.43	
							77	0.08	
							113	< 0.05	
							126	< 0.05	
Requinoa, Chile, 1988 (variety not specified)	NS	0.18	0.01	1800	1	10–15 mm diameter fruit	15	0.28	UCH-R
							36	0.07	
							49	< 0.05	
							85	< 0.05	
							98	< 0.05	
	NS	0.36	0.02	1800	1	10–15 mm diameter fruit	15	0.46	
							36	0.17	
							49	0.09	
							85	0.12	
							98	0.05	
Teno, Chile, 1988 (Red King Oregon)	NS	0.16	0.01	1560	1	Pink bud	150	< 0.05	CHA 187001
		0.23	0.02				150	< 0.05	
		0.31	0.02				150	< 0.05	
Chimbarongo-Rosselot, Chile, 1988 (Granny-spur)	NS	0.35	0.01	3500	1	90% bloom	148	< 0.05	CHA 187002
		0.52	0.02				148	< 0.05	
		0.70	0.02				148	< 0.05	
Chimbarongo-Donoso, Chile, 1988 (Red King Oregon)	NS	0.86 & 0.64	0.02 & 0.015	4280	2	Pink bud 7–8mm fruit	127	< 0.05	CHA 187003
Chimbarongo-Donoso, Chile, 1988 (Granny-spur)	NS	0.44	0.01		1			< 0.05	
		0.64	0.02			50% bloom	146	< 0.05	
		0.86	0.02					< 0.05	
Olivar-Alto, Chile, 1988 (Red-spur)	NS	0.32	0.01	3180	1	Pink bud 10% bloom	145	< 0.05	CHA 187004
		0.48	0.02				145	< 0.05	
		0.64	0.02				145	< 0.05	
Pelequen, Chile, 1988	NS	0.59	0.02	3950	1	8 mm fruit	125	< 0.05	CHA 187005
		0.40	0.01			95% bloom	141	< 0.05	

Trial location, Country, Year (Variety)	Application					Growth Stage	DAT, days	Flufenoxuron Residues (mg/kg)	Ref
	Form	kg ai/ha	kg ai/hL	Water, L/ha	no.				
(Red King Oregon)		0.59	0.02			95% bloom	141	< 0.05	
		0.79	0.02			95% bloom	141	< 0.05	
Molina, Chile, 1988 (Red King Oregon)	NS	0.16	0.01	1650	1			< 0.05	CHA 187006
		0.25	0.02			80% bloom	139	< 0.05	
		0.33	0.02					< 0.05	
Curico, Chile, 1988 (Granny spur)	NS	0.57	0.01	5680	1	100% petal	138	< 0.05	CHA 187007
Curico Chile, 1988 (Richared)	NS	0.85	0.02	5680	1	50% petal	138	< 0.05	
		1.14	0.02					< 0.05	
Rosario, Chile, 1988 (Richared Delicious)	NS	0.44	0.01	4360	1			< 0.05	CHA 187008
		0.65	0.02			Fruit set 2 mm fruit	133	< 0.05	
		0.87	0.02					< 0.05	
Tinguiririca, Chile, 1988 (Red King Oregon & Red Dpur)	NS	0.77	0.01	5140	1	Fruit set	131	< 0.05	CHA 187009
		1.03	0.02					< 0.05	
Requinoa, Chile, 1990 (Red Spur)	DC 100 g/L	0.42	0.05	8320	1	Developing fruit 10 mm	6	0.24	FX-711-028
							20	0.07	
							41	0.04	
							55	0.02	
							harvest	<0< 0.01	
	DC 100 g/L	0.62	0.08	8320	1	Developing fruit 10 mm	6	0.32	
							20	0.23	
							41	0.16	
							55	0.03	
							harvest	<0< 0.01	

NS: Not specified

Pears

Two trials were conducted on a same site located in Chile, during the 1990 growing season, on pears treated once early season with a DC formulation at rates of 0.2–0.38 kg ai/ha and harvested 0–60 days following application.

Table 36 Residue decline of Flufenoxuron in pears following foliar spray with DC Formulation

Trial location, Country, Year (Variety)	Application					Growth Stage	DAT, days	Flufenoxuron Residues (mg/kg)	Ref
	Form	kg ai/ha	kg ai/hL	Water, L/ha	no.				
Requinoa, Chile, 1990 (Red Spur)	DC 100 g/L	0.2	NS	NS	1	Developing fruit	0 6 20 27 41 60	1.0 0.45 0.3 0.13 0.03 < 0.01	FX-711-028
	DC 100 g/L	0.38	NS	NS	1	Developing fruit	0 6 20 27 41 60	2.62 0.82 0.42 0.30 0.07 0.03	

NS: Not specified

Melons

Melons, grown in Brazil during the 2010 season, received four applications of a DC formulation of flufenoxuron at 0.01 kg ai/hL, with 4–7 day re-treatment intervals, and harvested 0–10 days following the last application. For some trials, residues in pulp and peel were determined from whole fruit, based on a ratio of 40% peel and 60% pulp.

Table 37 Residues of flufenoxuron in field grown melons following foliar spray with DC formulation

Location, year (Variety)	Application						Growth Stage	DAT, days	Matrix	Flufenoxuron Residues (mg/kg) [b]	Ref
	Form	kg ai/ha	kg ai/hL	Water, L/ha	no.	RTI, days					
Ponta Grossa, Brazil, 2010 (Redondo Gaucho)	DC 100 g/L	0.10	0.01	1000	4	4	89	10	Whole Fruit	0.07	G080414
Assai, Brazil, 2010 (Hibrido Louis)	DC 100 g/L	0.10	0.01	1000	4	4	77	10	Whole Fruit	0.03	G080415
Mossoro, Brazil, 2010 (Galia)	DC 100 g/L	0.10	0.01	1000	4	4	81	10	Whole Fruit	0.03	G080416
Anhembi, Brazil, 2010 (Casca de Carvalho)	DC 100 g/L	0.10	0.014	700	4	NS	83	0	Peel	0.20	EC-CD-BRUA/1099-06
								0	Pulp	0.08	
								0	Whole Fruit [a]	0.13	
								1	Peel	0.16	
								1	Pulp	0.06	
								1	Whole Fruit [a]	0.10	
								3	Peel	0.17	
								3	Pulp	0.08	
								3	Whole Fruit [a]	0.12	
								5	Peel	0.15	
								5	Pulp	0.03	
								5	Whole Fruit [a]	0.08	
								7	Peel	0.08	
								7	Pulp	< 0.01	
								7	Whole Fruit [a]	0.04	
								10	Peel	0.10	
								10	Pulp	< 0.01	
								10	Whole Fruit [a]	0.05	
Icapui, Brazil, 2010 (Amarelo Gold Mine)	DC 100 g/L	0.10	0.014	700	4	NS	80	0	Peel	0.16	EC-CD-BRUC/1099-06
								0	Pulp	0.01	
								0	Whole Fruit [a]	0.07	
								1	Peel	0.14	
								1	Pulp	0.01	
								1	Whole Fruit [a]	0.06	
								3	Peel	0.09	

Location, year (Variety)	Application						Growth Stage	DAT, days	Matrix	Flufenoxuron Residues (mg/kg) [b]	Ref
	Form	kg ai/ha	kg ai/hL	Water, L/ha	no.	RTI, days					
								3	Pulp	0.01	
								3	Whole Fruit [a]	0.04	
								5	Peel	0.07	
								5	Pulp	< 0.01	
								5	Whole Fruit [a]	0.03	
								7	Peel	0.17	
								7	Pulp	< 0.01	
								7	Whole Fruit [a]	0.07	
								10	Peel	0.1	
								10	Pulp	0.02	
								10	Whole Fruit [a]	0.05	
Anhembi, Brazil, 2010 (Casca de Carvalho)	DC 100 g/L	0.10	0.014	700	4	NS	83	3	Peel	0.17	EC-R-BRUA/1099-06
								3	Pulp	0.01	
								3	Whole Fruit [a]	0.07	
								7	Peel	0.09	
								7	Pulp	< 0.01	
								7	Whole Fruit [a]	0.04	
Mossoro, Brazil, 2010 (Amarelo Gold Mine)	DC 100 g/L	0.10	0.014	700	4	NS	80	3	Peel	0.14	EC-R-BRUB/1099-06
								3	Pulp	< 0.01	
								3	Whole Fruit [a]	0.06	
								7	Peel	0.1	
								7	Pulp	< 0.01	
								7	Whole Fruit [a]	0.05	
Anhembi, Brazil, 2010 (Imperial)	DC 100 g/L	0.10	0.014	700	4	NS	84	3	Peel	0.19	EC-R-BRUB/11099-06
								3	Pulp	0.18	
								3	Whole Fruit [a]	0.18	
								7	Peel	0.11	
								7	Pulp	< 0.01	
								7	Whole Fruit [a]	0.05	
Lodrina, Brazil, 2010 (Lovis)	DC 100 g/L	0.10	NS	NS	4	4	85	0	Peel	0.46	G100218
									Pulp	< 0.01	
									Whole Fruit	0.12	
							79	3	Peel	0.54	
									Pulp	< 0.01	
									Whole Fruit	0.09	
							75	7	Peel	0.33	

Location, year (Variety)	Application						Growth Stage	DAT, days	Matrix	Flufenoxuron Residues (mg/kg) [b]	Ref
	Form	kg ai/ha	kg ai/hL	Water, L/ha	no.	RTI, days					
									Pulp	< 0.01	
									Whole Fruit	0.07	
Ibipora, Brazil, 2010 (Lovis)	DC 100 g/L	0.10	NS	NS	4	4	61	0	Peel	0.73	G100219
									Pulp	< 0.01	
									Whole Fruit	0.2	
							57	3	Peel	0.27	
									Pulp	< 0.01	
									Whole Fruit	0.08	
							51	7	Peel	0.28	
									Pulp	< 0.01	
									Whole Fruit	0.08	
Senador Canedo, Brazil, 2010 (Gaúcho)	DC 100 g/L	0.10			4	4	87	3	Peel	0.55	G100220
									Pulp	0.02	
									Whole Fruit	0.21	
Mossoro, Brazil, 2010 (Goldex)	DC 100 g/L	0.10			4	4	79	3	Peel	0.29	G100221
									Pulp	< 0.01	
									Whole Fruit	0.06	

NS: Not specified
[a] Calculated assuming a weight ratio of 40% peel and 60% pulp
[b] Residues < LOQ were assumed to be at 0.01 mg/kg

Tomato

Tomatoes, grown in Spain during the 2008 season and maintained under protective cover, were treated twice with a DC formulation of flufenoxuron at 0.12–0.13 kg ai/ha and 14 day re-treatment interval. Mature tomatoes were harvested 0–7 days following the last application.

During the 2008 season, field tomatoes grown in Brazil were treated with four applications of a DC formulation of flufenoxuron at 0.01 kg ai/hL and a 7-day re-treatment interval. Tomatoes were harvested 0–7 days following the last application.

Table 38 Residues of flufenoxuron in tomatoes following spray with DC formulation

Trial location, Country, Year (Variety)	Application						Growth Stage	DAT, days	Flufenoxuron Residues (mg/kg)	Ref
	Form	kg ai/ha	kg ai/hL	Water, L/ha	no.	RTI, days				
Conil de la Frontera, Spain, 2008 (Caramba) Protected	DC 100 g/L	0.12–0.13	0.01	1180–1271	2	14	84 85– 86	0	0.067	AF/12238/PM/1
								3	0.093	
								5	0.084	
								7	0.089	
Conil de la Frontera, Spain, 2008 (Bond)	DC 100 g/L	0.13	0.01	1282–1288	2	14	64 71	7	0.07	AF/12238/PM/2

Trial location, Country, Year (Variety)	Application						Growth Stage	DAT, days	Flufenoxuron Residues (mg/kg)	Ref
	Form	kg ai/ha	kg ai/hL	Water, L/ha	no.	RTI, days				
Protected										
Los Palacios Y Villafranca, Spain, 2008 (V1) Protected	DC 100 g/L	0.12–0.13	0.01	1215–1340	2	14	72 73	7	0.09	AF/12238/PM/3
Zaragoza, Spain, 2008 (Caramba) Protected	DC 100 g/L	0.12–0.13	0.01	1243–1300	2	14	77 81	0 3 5 7	0.16 0.21 0.32 0.24	AF/12238/PM/4
Santa Engracia, Spain, 2008 (Caramba) Protected	DC 100 g/L	0.12–0.13	0.01	1200–1286	2	14	75 77	7	0.1	AF/12238/PM/5
Remolinos, Spain, 2008 (Caramba) Protected	DC 100 g/L	0.13	0.01	1282–1299	2	14	73 87–89	7	0.23	AF/12238/PM/6
Cambados, Spain, 2008 (Disie) Protected	DC 100 g/L	0.13	0.01	1270–1294	2	14	71 73	7	0.1	AF/12238/PM/7
Paende San Vicente Meis, Spain, 2008 (Caramba) Protected	DC 100 g/L	0.12–0.13	0.01	1230–1298	2	14	71 72	7	0.14	AF/12238/PM/8
Ponta Grossa, Brazil, 2008 (Raissa) Field	DC 100 g/L	0.10	0.01	1000	4	7	80	0 3 5 7 10	0.08 0.08 0.07 0.08 0.06	EC-CD-BRTA/1162-06
Santo Antonio de Posse, Brazil, 2008 (Bonus F1) Filed	DC 100 g/L	0.10	0.01	1000	4	7	85	0 3 5 7 10	0.38 0.37 0.36 0.37 0.21	EC-CD-BRUA/1162-06
Araguari, Brazil, 2008 (Alambra) Field	DC 100 g/L	0.10	0.01	1000	4	7	83	3 7	0.07 0.08	EC-R-BRVA/1162-06
Ipiranga, Brazil, 2008 (Raissa) Field	DC 100 g/L	0.10	0.01	1000	4	7	78	3 7	0.05 0.04	EC-R-BRTB/1162-06
Santo Antonio de Posse, Brazil, 2011 (Italiano	DC 100 g/L	0.10	0.01	1000	4	7	89	3 7	0.18 0.19	G100074

Trial location, Country, Year (Variety) Comprido) Field	Application						Growth Stage	DAT, days	Flufenoxuron Residues (mg/kg)	Ref
	Form	kg ai/ha	kg ai/hL	Water, L/ha	no.	RTI, days				
Senador Canedo, Brazil, 2011 (Carolina) Field	DC 100 g/L	0.10	0.01	1000	4	7	84	3	0.02	G100075
								7	0.02	

Tea

Eleven trials conducted on tea, grown in Japan during the 2005–2007 growing seasons, were treated twice or five times with an EC formulation of flufenoxuron at a rate of 0.0025 kg ai/hL. The re-treatment intervals were not specified in the study report. Tea leaves were harvested 1–14 days following application. On the day of sampling, tea leaves were processed in accordance with the standard green tea processing procedure and individually tightly sealed in a tea can prior to transportation

Table 39 Residues of flufenoxuron in tea (green) following spray with EC formulation

Trial location, Country, Year (Variety)	Application					Growth Stage [a]	DAT, days	Matrix [c]	Flufenoxuron Residues (mg/kg)	Ref
	Form	g ai/ha	0.0025 kg ai/hL	Water, L/ha	no					
cGAP Japan	EC	50–100	25	2000–4000	2/7–14 day RTI		7			
Kagoshima, Japan, 2005 (Okumidori)	EC (10%)	100	25	4000	2	1.0, 2.5	7	Tea (green)	4.58	217858
Shizuoka, Japan, 2005 (Yabukita)	EC (10%)	100	25	4000	2	0.5–1.5, 2.0–3.0	7	Tea (green)	6.02	
Kyoto, Japan, 2005 (Kanayamidori)	EC (10%)	100	25	4000	2	2.0, 3.0	7	Tea (green)	6.23	
Mie, Japan, 2005 (Sayamakaori)	EC (10%)	100	25	4000	2	1.5, 3.0	7	Tea (green)	11.8	
Fukuoka, Japan, 2005 (Meiryoku)	EC (10%)	100	25	4000	2	1.0–1.5, 2.5–3.0	7	Tea (green)	3.95	
Myazaki, Japan, 2005 (Fuushun)	EC (10%)	100	25	4000	2	2.0, 3.0	7	Tea (green)	2.48	
Shizuoka, Japan, 2005 (Yabukita)	EC (10%)	100	25	4000	2	0.5–1.5, 2.0–3.0	7	Tea (green)	2.37	
Japan, 2007 (Okumidori)	EC (10%)	100	25	4000	5	4.0–5.0 [b]	1	Tea (green)	12	P/B 1340G
						3.0–4.0 [b]	7	Tea (green)	6.4	
						2.0–3.0 [b]	14	Tea (green)	3.1	
Japan, 2007 (Yabukita)	EC (10%)	100	25	4000	5	4.0 [b]	1	Tea (green)	14	
						3.0 [b]	7	Tea (green)	5.9	

Trial location, Country, Year (Variety)	Application					Growth Stage [a]	DAT, days	Matrix [c]	Flufenoxuron Residues (mg/kg)	Ref
	Form	g ai/ha	0.0025 kg ai/hL	Water, L/ha	no					
						1.0 [b]	14	Tea (green)	2.4	
Japan, 2007 (Komakage)	EC (10%)	100	25	4000	5	3.5 [b]	1	Tea (green)	13	
						3.5 [b]	7	Tea (green)	6.1	
						2.0 [b]	14	Tea (green)	1.4	
Japan, 2007 (Yabukita)	EC (10%)	100	25	4000	5	4.0–5.0 [b]	1	Tea (green)	19	
						3.5–4.0 [b]	7	Tea (green)	7.4	
						1.5–2.0 [b]	14	Tea (green)	2.7	

[a] Leaf stage
[b] Leaf stage at last application
[c] On the day harvested, tea leaves were processed in accordance with the standard green tea processing procedure and individually tightly sealed in a tea can prior to transportation

FATE OF RESIDUES IN STORAGE AND PROCESSING

Nature of residue during processing

The hydrolysis of flufenoxuron under processing conditions was investigated by Hassink, J. (2003/1000985). [Difluorobenzamide-ring-U-^{14}C]-flufenoxuron and [fluoroaniline-ring-U-^{14}C]-flufenoxuron were diluted in sterile buffered aqueous solution at a nominal concentration of 1 µg ai/L, which corresponds to approximately 50% of the water solubility (at pH 4). Incubation was done at three representative sets of hydrolysis conditions: 90 °C, pH 4 for 20 minutes (pasteurisation); 100 °C, pH 5 for 60 minutes (baking, brewing and boiling) and 120 °C, pH 6 for 20 minutes (sterilisation).

Parent compound and potential hydrolysis products were identified and quantified by HPLC-UV.

Thin layer chromatography was used for confirmation of the identity of the test item by co-chromatography with the non-labelled reference item. Material balances were established for each set of hydrolysis conditions.

Table 40 Hydrolysis of flufenoxuron under simulated processing conditions

Hydrolysis Conditions	Incubation time (min)	[difluorobenzamide-ring-U-^{14}C]-flufenoxuron		[fluoroaniline-ring-U-^{14}C]-flufenoxuron	
		Analyte	% applied radioactivity	Analyte	% applied radioactivity
Pasteurization: pH 4, 90 ºC	20	Flufenoxuron	90.0	Flufenoxuron	92.7
		Unidentified	2.6		
		Total Recovery	92.6	Total Recovery	92.7
Baking, boiling, brewing procedure (pH 5, 100 °C)	60	Flufenoxuron	66.3	Flufenoxuron	
		Reg. No. 102719	32.0	Reg. No. 4064703 or Reg. No. 241208	4.3
		Unidentified	1.9	Unidentified	2.9
		Total Recovery	104.3	Total Recovery	95.7
Sterilization (pH 6, 120 °C)	20	Flufenoxuron	83.5	Flufenoxuron	62.7
		Reg. No. 102719	7.6	Reg. No. 4064702	3.8
		Reg. No. 206925	9.2	Reg. No. 4064703 or Reg. No. 241208	9.5

		Reg. No. 4964847	3.5	Reg. No. 4964847	9.2
		Unidentified	0.2	Unidentified	2.9
		Total Recovery	105.4	Total Recovery	88.1

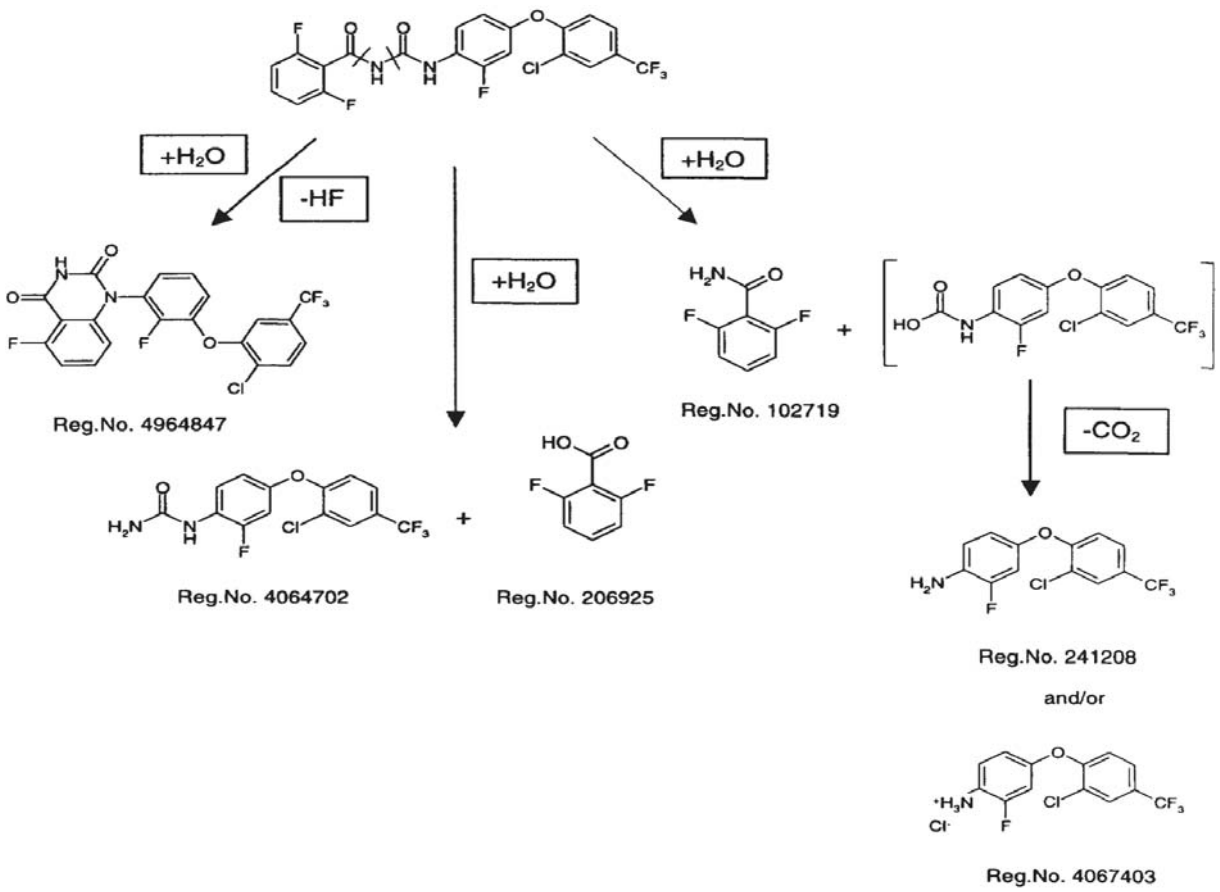


Figure 1 Pathway of hydrolysis of flufenoxuron

Residues after processing

The fate of flufenoxuron during processing of raw agricultural commodity (RAC) was investigated in tomatoes and tea using commercial processing procedures. As a measure of the transfer of residues into processed products, a processing factor (PF) was used, defined as:

$$PF = \frac{\text{Total residue in processed product (mg/kg)}}{\text{Total residue in raw agricultural commodity (mg/kg)}}$$

If residues in the RAC were below the LOQ, no processing factor could be derived. In case of residues below the LOQ, but above the LOD in the processed product, the numeric value of the LOQ was used for the calculation. If residues in the processed product were below the LOD, the numeric value of the LOQ was used for the calculation but the PF was expressed as "less than" (e.g. < 0.5).

A summary of all processing factors for flufenoxuron relevant for the estimation of maximum residue levels of the dietary intake is given in Table 41.

Tomato

Study 1

During the 2002 growing season, four field trials were conducted in field tomatoes in different representative growing areas in southern France and Spain (Smalley R., 2003a; 2003/1004346). The treatment program consisted of three foliar applications of a 100 g/L DC formulation of flufenoxuron at a rate of 0.62 kg ai/ha/application The tomatoes were harvested 6–7 days following the last application, washed and processed according to commercial practices into pomace, juice, sauce and canned tomatoes.

All samples were analysed for flufenoxuron according to method RLA 12675. The limit of quantitation (LOQ) was 0.05 mg/kg.

Samples of processed commodities were stored for up to 600 days prior to analysis of flufenoxuron which is within the demonstrated storage interval for the parent compound in high oil, high acid and high water content matrices.

In the following table, the residues found in processed products are summarised.

Table 41 Residues of flufenoxuron in processed tomato commodities and calculation of processing factors

Location, year, reference (variety)	No.	kg ai/ha	Sample	DAT (days)	Flufenoxuron								
					Residues (mg/kg)				PF [a]				Median PF
S. France and Spain, 2002, 2003/1004346 (Avalon, Ercolé, Perfect Peel, Select Peel)	3	0.62	Tomato	6–7	0.26	1.23	0.41	0.74	–				–
			Tomato before processing		0.14	0.72	0.25	0.51	0.54	0.59	0.61	0.69	0.60
			Washed tomatoes		0.23	0.44	0.29	0.42	0.88	0.36	0.71	0.57	0.63
			Wash water		< 0.05	0.46	n.a.	0.07	0.19	0.37	n.a. [b]	0.09	0.19
			Wet pomace		0.43	0.89	0.43	0.96	1.65	0.72	1.05	1.30	1.18
			Raw juice		0.09	0.49	0.15	0.33	0.35	0.40	0.37	0.45	0.39
			Tomato juice		0.07	0.36	0.13	0.22	0.27	0.29	0.32	0.30	0.30
			Waste puree		1.75	3.53	1.86	2.21	6.73	2.87	4.54	2.99	3.76
			Tomato puree		0.20	0.59	0.23	0.65	0.77	0.48	0.56	0.88	0.67
			Blanching water		< 0.05	< 0.05	< 0.05	< 0.05	0.19	0.04	0.12	0.07	0.10
			Peels		1.54	6.61	1.92	3.52	5.92	5.37	4.68	4.76	5.02
			Peeled tomatoes		< 0.05	< 0.05	< 0.05	< 0.05	0.19	0.04	0.12	0.07	0.10
			Canned tomatoes [c]		< 0.05	0.17	0.05	0.08	0.19	0.14	0.12	0.11	0.13

[a] Processing factor (PF) = residue in processed fraction / residue in RAC
[b] n.a. = sample was not analysed
[c] Raw juice is also added to peeled tomatoes during the process of canning

Study 2

A processing study was conducted in Southern France to determine the residue levels of flufenoxuron and the metabolites Reg. No. 4064702, Reg. No. 102719, Reg. No. 206925, Reg. No. 241208, Reg. No. 4064703 and Reg. No. 4964847 in tomato RAC and processed fractions including canned tomatoes, tomato puree and tomato juice (Ertus, C., 2013; ANADIAG).

The treatment program consisted of a single foliar application of a 100 g/L formulation of flufenoxuron at a rate of 0.5 kg ai/ha made 7 days prior to harvest at the growth stage BBCH 89.

The tomatoes were washed and processed according to the following commercial practices:

For juice production, approximately 8 kg of tomatoes were roughly cut and blended. The mixture obtained was filtered through a fine sieve to separate the juice from peels and seeds. The Brix degree and the pH of the raw juice were determined and the raw juice was heated to 95 °C for 5 minutes. Subsamples of pasteurized juice were stored frozen until analysis.

For production of tomato puree, a juice sample was concentrated under vacuum and gentle heating to 60 °C until reaching a Brix degree of 12. The obtained puree was pasteurized by heating to 95 °C for 5 minutes in a can.

For canning, approximately 2 kg of tomatoes were submerged for about 60 seconds in boiling water and transferred into cold water for 20 seconds to crack the peel. After peeling, subsamples were transferred into glass preserving jars, which were filled up with water, closed and submitted to sterilization. After cooling, canned tomatoes were blended and subsamples were stored frozen until analysis.

All samples were analysed for flufenoxuron and the metabolites according to a method adapted from `Flufenoxuron: Development and Validation of an Analytical Method for Determination and Confirmation of BAS 307I (Flufenoxuron) and its Degradates in Grape—PTRL Europe Study No.P/B1206G`. Briefly, residues were extracted using a mixture of methanol, water and HCl. The centrifuged extract was analysed by LC/MS/MS. The limit of quantification (LOQ) was reported to be 0.01 mg/kg.

Samples of processed commodities were stored for up to 33 days prior to analysis of flufenoxuron and all metabolites which is within the demonstrated storage interval for the parent compound in high oil, high acid and high water content matrices.

In the following table, the residues found in processed products are summarised.

Table 42 Residues of Flufenoxuron and associated metabolites in processed tomato commodities and calculation of processing factors

Location, year, reference (variety)	No.	kg ai/ha	Sample	DAT(days)	Residues (mg/kg)							PF [a]
					Flufenoxuron	Reg. No. 4064702	Reg. No. 102719	Reg. No. 206925	Reg. No. 241208	Reg. No. 464703	Reg. No. 4964847	Flufenoxuron
S. France, 2012, ANADI AG (Rio Grande)	3	0.5	Tomato	6–7	0.28	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	–
			Fresh tomatoes		0.18	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.64
			Canned tomatoes		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.04
			Tomato puree		0.08	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.28
			Tomato juice		0.04	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.14

[a] Only processing factors for flufenoxuron were reported as residues of all other metabolites were not detected above the limit of quantitation (0.01 mg/kg).

Tea

Two residue trials were conducted in 1990 in Kyoto and Kagoshima, Japan (Class, T., 2007a). Flufenoxuron was applied either once or twice at a rate of 0.0025 kg ai/hL and leaves were harvested 7–14 days following application.

An infusion was prepared from the treated dried green tea leaves by adding 360 mL boiling water to 6 g tea and leaving to stand for five minutes.

Dried tea (green) leaves and tea infusion were analysed using the HPLC-UV method titled Pesticide Residue Analysis for Crop (Shell Corporation, 1996). In summary, the method involves extracting flufenoxuron residues with acetone, in the presence of zinc acetate. The filtrates were extracted with ethyl acetate and subjected to hexane/acetonitrile partition after which the acetonitrile phase is purified using a florisil cartridge prior to HPLC–UV analysis. The limit of quantitation for both tea leaves and tea infusion was reported as 0.02 mg/kg, each.

Samples of tea leaves and tea infusion were stored for up to 108 days prior to analysis of flufenoxuron which is within the demonstrated storage interval for parent in high oil, high acid and high water content matrices.

Table 43 Determination of transfer of residues from treated dried tea (green) leaves to tea infusion

	Treatment times	DAT [a]	Residues in dried tea (green)leaves (mg/kg)		Residues in tea infusion (mg/kg)		% transfer from dried tea (green) leaves to tea infusion
			Found	Mean	Found	Mean	
Kyoto	1	7	6.66, 6.26	6.46	0.04, 0.04	0.04	0.62
	1	14	5.57, 5.18	5.36	0.03, 0.03	0.03	0.56
	2	7	7.98, 7.89	7.94	0.06, 0.05	0.06	0.76
	2	14	6.33, 5.96	6.14	0.04, 0.03	0.04	0.65
Kagoshima	1	7	7.75, 7.57	7.65	0.05, 0.05	0.05	0.65
	1	14	4.09, 4.08	4.08	0.03, 0.03	0.03	0.74
	2	7	7.24, 7.19	7.22	0.05, 0.05	0.05	0.69
	2	14	3.63, 3.53	3.58	0.02, 0.02	0.02	0.56
Median transfer							0.65

RESIDUES IN ANIMAL COMMODITIES

Farm animal feeding studies

For the estimation of residues of flufenoxuron in animal matrices lactating cow and laying hen feeding studies were submitted to the Meeting.

Lactating dairy cattle

Residues of flufenoxuron in lactating cows were investigated by Gilland Pack (1993). Flufenoxuron was administered orally to fifteen lactating Friesian dairy cows (three cows/control and treatment group and a depuration group consisting of three cows), between 4–7 years of age and in the weight range of 466–602 kg, for 90 consecutive days. Based on a feeding rate of approximately 20 kg/day, dose levels were 1.75, 5.25 and 17.5 mg/kg feed corresponding to 0.07, 0.21 and 0.7 mg/kg bw/day. Animals were dosed twice daily at half of the daily rate at each milking. The average daily milk production ranged from 13–21 kg starting 14 days prior to dosing up to the last day of dosing. The fat content of milk samples taken on days 7, 28, 56 and 90 of the study ranged from 2.5–4.3%.

Milk was collected twice daily. At the end of the dosing period, two composite milk samples were taken for processing to pasteurized milk, cream, skimmed milk and acid whey.

Three animals from the highest dose level group and one control animal were monitored for flufenoxuron residues over a 40-day depuration phase. Milk from these animals was sampled during the depuration period.

Approximately one day after the last day of dosing, the animals, with the exception of the cows of the depuration group, were sacrificed and liver, kidney, composite muscle (pectoralis/adductor muscle of thigh) and perirenal fat (perirenal/omental) were collected for analysis.

Analysis of the samples of milk and milk products was performed using the Analytical Method SAMS 486-1 with minor modifications. The limit of quantitation of this method for flufenoxuron in milk and milk products was reported to be 0.001 mg/L based on acceptable concurrent recoveries. Analysis of the bovine tissues was carried out in duplicate according to a slightly modified version of the Analytical Method SAMS 457-2. The lowest limit of method validation for flufenoxuron in animal tissues is 0.10 mg/kg for muscle, liver and kidney and 0.30 mg/kg for fat based on acceptable concurrent recoveries.

Residues of flufenoxuron in milk are presented in the following table:

Table 44 Residues of Flufenoxuron in milk after administration of Flufenoxuron at 1.75, 5.25 or 17.5 mg/kg feed/day

Study Day	Mean residues for flufenoxuron (mg/L)			
	Group A [a] control	Group B [a] 1.75 mg/kg diet	Group C [a] 5.25 mg/kg diet	Group D [b] 17.5 mg/kg diet
–3	< 0.001	< 0.001	< 0.001	< 0.001
–1	< 0.001	< 0.001	< 0.001	< 0.001
1	< 0.001	< 0.001	< 0.001	0.003 ((0.003, 0.002, 0.003, 0.003, 0.005, 0.002)
2	< 0.001	0.02 (0.025, 0.023, 0.025)	0.07 (0.059, 0.077, 0.068)	0.21 ((0.099, 0.12, 0.25, 0.35, 0.29, 0.13)
4	< 0.001	0.08 (0.091, 0.075, 0.084)	0.21 0.27, 0.24, 0.13)	0.71 (0.73, 0.66, 0.75, 0.87, 0.83. 0.41)
7	< 0.001	0.13 (0.11, 0.12, 0.15)	0.35 (0.45, 0.47, 0.18)	1.70 (1.6, 1.4, 1.7, 1.5, 1.9, 1.6)
10	0.001 (< 0.001, < 0.001, 0.002)	0.16 (0.14, 0.083, 0.27)	0.64 (0.72, 0.79, 0.40)	2.20 (2.1, 1.9, 2.5, 1.9, 2.6, 2.1)
14	0.001 (< 0.001, 0.001, 0.002)	0.27 (0.18, 0.33, 0.31)	0.70 ((0.54, 0.92, 0.54)	2.63 2.6, 2.6, 3.3, 2.9, 2.5, 1.9)
21	0.001 (< 0.001, 0.001, 0.001)	0.34 (0.32, 0.30, 0.41)	0.89 (0.81, 1.3, 0.57)	3.53 (4.6, 4.1, 4.7, 2.1, 3.1, 2.6)
28	0.001 (< 0.001, < 0.001, 0.001)	0.437 (0.39, 0.41, 0.51)	1.33 (1.4, 1.6, 1.0)	3.57 (4.3, 3.1, 3.7, 3.4, 4.0, 2.9)
35	0.0013 (< 0.001, < 0.001, 0.003)	0.460 (0.40, 0.49, 0.49)	1.37 (1.4, 1.6, 1.1)	3.72 (4.5, 2.6, 4.2, 3.9, 4.4, 2.7)
42	0.025 (0.002, 0.002, 0.07)	0.420 (0.40, 0.42, 0.44)	1.20 (1.1, 1.4, 1.1)	3.98 (4.4, 4.0, 4.4, 3.4, 3.8, 3.9)
56	0.003 (< 0.001, 0.002, 0.007)	0.493 (0.47, 0.51, 0.50)	1.57 (1.6, 1.8, 1.3)	5.02 (5.6, 4.6, 5.0, 5.1, 4.9, 5.0)
70	0.001 (< 0.001, < 0.001, 0.001)	0.58 (0.62, 0.56, 0.57)	1.80 (2.0, 1.8, 1.8)	5.45 (5.1, 5.8, 5.3, 5.8, 5.3, 5.4)
86	0.001 (0.001, 0.001, < 0.001)	0.64 (0.60, 0.75, 0.56)	1.53 (1.5, 1.6, 1.5)	5.47 96.2, 4.7, 5.0, 6.2, 4.8, 5.9)
90	0.001 (0.002, 0.001, < 0.001)	0.64 (0.77, 0.64, 0.51)	1.90 (2.2, 2.0, 1.5)	5.53 (6.5, 5.6, 5.4, 5.1, 4.4, 6.2)
Depuration Phase				
91	0.001 (0.001, 0.001, < 0.001)	–	–	5.13 (4.1, 4.2, 5.6, 5.4, 4.5, 6.9)
92	< 0.001	–	–	4.63 (4.7, 4.0, 5.2)
94	< 0.001	–	–	4.67 (3.9, 3.7, 6.4)
97	< 0.001	–	–	3.27 (3.2, 2.1, 4.5)

Study Day	Mean residues for flufenoxuron (mg/L)			
	Group A [a] control	Group B [a] 1.75 mg/kg diet	Group C [a] 5.25 mg/kg diet	Group D [b] 17.5 mg/kg diet
101	0.002	–	–	2.60 (2.7, 1.7, 3.4)
106	< 0.001	–	–	2.07 (2.1, 1.1, 3.0)
112	< 0.001	–	–	1.43 (1.7, 0.59, 2.0)
118	< 0.001	–	–	1.20 (1.3, 0.69, 1.7)
124	< 0.001	–	–	0.95 (1.1, 0.45, 1.3)
130	< 0.001	–	–	0.92 8.84, 0.61, 1.3)

[a] Mean values of three animals
[b] Mean values of six animals, three animals during depuration phase

Pasteurised milk, cream, skimmed milk and acid whey were prepared from pooled control milk (group A) and from pooled milk from the high-dose group (D) at the end of the 90 day dosing period. The mean results of the analyses of those milk products for both treatment groups are summarised in Table 45.

Table 45 Mean residues of Flufenoxuron in milk products after 90 days of dosing.

Product	Mean residues of flufenoxuron in milk products [mg/L]	
	Group A (Control)	Group D (17.5 mg/kg diet)
Raw Milk	0.001	5.5
Pasteurized Milk	0.012	6.4
Cream	0.007	28
Skimmed Milk	< 0.001	0.18
Acid Whey	< 0.001	0.06

Analysis of milk obtained from the high dose group showed that pasteurization had no effect on the levels of flufenoxuron in milk. Residues in cream were concentrated by a factor of 1.5. In skimmed milk and acid whey, residues were reduced compared to the raw milk.

The mean residue levels and individual sample residues in tissues are summarized in Table 46 for each treatment group.

Table 46 Residues of Flufenoxuron in bovine tissues collected 90 days following the last administered dose

Tissue type	Residues of Flufenoxuron in tissues [mg/kg]				
	Group A [a] control	Group B [b] 1.75 mg/kg diet	Group C [b] 5.25 mg/kg diet	Group D [b] 17.5 mg/kg diet	Group D [b] day 40 depuration
Muscle	< 0.03 (< 0.03, < 0.03)	0.14 [0.08, 0.20 (0.14) 0.12, 0.08 (0.10) 0.28, 0.08 (0.18)]	0.66 [0.67, 0.49 (0.59) 0.24, 0.38 (0.31) 1.2, 0.91 (1.1)]	1.63 [1.7, 1.7 (1.7) 1.8, 1.9 (1.9) 1.4, 1.3 (1.4)]	0.25 [0.28, 0.39 (0.34) 0.03, 0.06 (0.04) 0.27, 0.48 (0.37)]
Liver	< 0.03 (< 0.03, < 0.03)	0.74 [0.70, 0.83 (0.77) 0.83, 0.79 (0.81) 0.68, 0.64 (0.66)]	2.17 [2.2, 2.3 (2.3) 1.8, 2.1 (2.0) 2.2, 2.3 (2.3)]	8.70 [9.0, 11.0 (9.8) 7.5, 7.6 (7.6) 8.3, 9.3 (8.8)]	0.92 [1.0, 1.4 (1.2) 0.23, 0.28 (0.25) 1.0, 1.6 (1.3)]

Tissue type	Residues of Flufenoxuron in tissues [mg/kg]				
	Group A [a] control	Group B [b] 1.75 mg/kg diet	Group C [b] 5.25 mg/kg diet	Group D [b] 17.5 mg/kg diet	Group D [b] day 40 depuration
Kidney	< 0.03 (< 0.03, < 0.03)	0.34 [0.40, 0.24 (0.32) 0.43, 0.44 (0.44) 0.31, 0.23 (0.27)]	1.60 [(1.8, 1.1 (1.4) 1.1, 1.0 (1.1) 2.7, 2.1 (2.4)]	4.30 [5.4, 3.0 (4.2) 7.2, 4.0 (5.6) 3.2, 2.9 (3.1)]	0.71 [1.5, 1.0 (1.3) 0.19, 0.14 (0.17) 0.92, 0.40 (0.66)]
Subcutaneous Fat	< 0.03 (< 0.03, < 0.03)	0.84 [1.1, 2.9 (2.0) 0.37, 0.42 (0.39) 0.16, 0.12 (0.14)]	9.27 [13, 13 (13) 3.6, 4.0 (3.8) 7.4, 15 (11)]	8.70 [5.1, 9.9 (7.5 18, 11 (15) 4.1, 3.1 (3.6)]	3.467 [6.9, 4.8 (5.9) 0.77, 0.42 (0.60) 2.0, 5.8 (3.9)]
Peritoneal Fat	0.04 (0.04, 0.04)	2.31 [3.4, 6.9 (5.2) 1.3, 0.86 (1.1) 0.69, 0.56 (0.62)]	17.27 [22, 20 (2.1) 6.4, 7.2, (6.8) 25, 23 (24)]	29.33 [44, 47 (45) 28, 27 (28) 14, 16 (15)]	7.63 [12, 12 (12) 2.6, 2.2, (2.4) 9.2, 7.7 (8.5)]

[a] Only one control animal was sacrificed at the end of the 90-day dosing period
[b] Mean of three animals; for each animal two separate analyses were conducted for each tissue

Laying hen

Seventy five white female Leghorn laying hens (three subgroups per control and treatment group, five hens per subgroup; the depuration group consisted of three subgroups of five hens/subgroup), aged 8–9 months and weighing 1303–1896 g, were dosed orally (gavage) once daily with flufenoxuron for 50 consecutive days at 1, 3 and 10 mg/kg feed, based on a daily consumption of 150 g/bird/day, equivalent to 0.15, 0.45 and 1.5 mg/kg bw/day. The average lay efficiency was 0.5 egg/hen/day.

Eggs were collected daily and separated into yolks and whites then pooled by subgroup (of five hens), resulting in three replicate daily samples per treatment group.

Fifteen animals from the top dose group and ten animals from the control group were monitored for flufenoxuron residues over a 40-day depuration phase. Eggs from these animals were sampled during the depuration period.

One day after the last day of dosing (day 40), the birds, with the exception of those of the depuration group, were sacrificed and samples of skin, muscle (breast, leg and thigh pooled), fat and liver (total organs) were taken separately for analysis and subdivided into two subsamples per subgroup.

The egg and tissue samples were analysed for residues of flufenoxuron using Analytical Method SAMS 492-1 and Analytical Method SAMS 457-2, respectively. The limit of quantitation for flufenoxuron is 0.25 mg/kg in egg yolk and 0.05 mg/kg in egg white and tissues based on acceptable concurrent recoveries. The liver samples were also analysed for the metabolite Reg. No. 4064702 using the HPLC/UV Analytical Method 01791.PCC with a limit of quantitation 0 0.03 mg/kg.

Egg white and yolk samples were analysed separately. Unless otherwise identified, in the majority of cases, no residues of flufenoxuron in egg white exceeded 0.05 mg/kg. The mean residue levels and range of residues in egg yolks are summarized in Table 47.

Table 47 Residues of Flufenoxuron in egg yolks.

Study Day	Mean (range) residues for flufenoxuron in egg yolks (mg/kg)			
	Group A (control)	Group B (1 mg/kg diet)	Group C (3 mg/kg diet)	Group D (10 mg/kg diet)
–3	< 0.25	< 0.25	< 0.25	< 0.25
–1	< 0.25	< 0.25	< 0.25	< 0.25
1	< 0.25	< 0.25	< 0.25	< 0.25
2	< 0.25	< 0.25	0.28(< 0.25–0.30)	0.40 (0.27–0.47)
4	0.27	< 0.25	0.63 (0.44–1.0)	1.87 (1.25–2.30)

Study Day	Mean (range) residues for flufenoxuron in egg yolks (mg/kg)			
	Group A (control)	Group B (1 mg/kg diet)	Group C (3 mg/kg diet)	Group D (10 mg/kg diet)
7	< 0.25	0.54 (0.45–0.70)	2.07 (1.74–2.30)	5.35 (4.07–6.99)
14	< 0.25	1.32 (1.02–1.70) [a]	4.02 (3.18–4.83)	10.23 (7.82–12.61)
21	< 0.25	2.08 (1.65–2.66)	4.92 (3.34–5.76)	15.43 (12.65–20.80)
28	0.47 (< 0.25–0.88)	2.14 (1.78–2.36)	4.70 (4.53–5.58)	17.18 (13.05–20.22)
35	0.49 (< 0.25–0.89)	2.26 (1.37–3.19)	6.22 (5.45–7.37)	19.56 (15.39–26.42)
42	0.62 (< 0.25–1.64)	2.68 (2.46–2.84)	6.06 (4.11–6.96)	25.19 (23.17–28.02)
50	0.25 (< 0.25–0.27)	3.09 (2.57–3.81)	8.01 (7.23–8.58)	28.03 (22.62–31.78)
Depuration phase				
51	0.34 (< 0.25–0.43) [b]	–	–	32.53 (24.52–39.55) [c]
52	< 0.25 [b]	–	–	30.74 (17.31–40.76) [c]
54	< 0.25 [b]	–	–	37.73 (27.21–46.64) [c]
57	< 0.25 [b]	–	–	18.45 (14.94–20.78) [c]
61	0.35(< 0.25–0.45) [b]	–	–	13.54 (6.74–19.24) [c]
66	< 0.25 [b]	–	–	10.48 (9.48–11.54) [c]
72	< 0.25 [b]	–	–	9.46 (5.34–11.66) [c]
78	< 0.25 [b]	–	–	4.57 (3.01–5.67) [c]
84	< 0.25 [b]	–	–	2.73 (1.90–3.59) [c]
90	< 0.25 [b]	–	–	2.27 (2.07–2.47) [c]

[a] The sample of Group B collected on Day 14 was the only egg sample in which Flufenoxuron was also detected in egg white (group mean residue of 0.13 mg/kg, but detected only in one out of three subgroups (subgroup B2)); in each other egg white sample analysed (Day –3 to Day 50), the Flufenoxuron concentration was below 0.05 mg/kg

[b] During the depuration period, only the eggs of one control subgroup (5 hens) were analysed

[c] During the depuration period, only the eggs of 15 hens at the highest dose level were analysed

The mean and range of residue concentrations of flufenoxuron in hen tissues are listed in Table 48.

Table 48 Residues of Flufenoxuron in tissues

Tissue type	Mean (range) residues of Flufenoxuron in tissues [mg/kg]				
	Group A	Group B (1 mg/kg diet)	Group C (3 mg/kg diet)	Group D (10 mg/kg diet)	Group D Day 40 depuration
Liver	0.09	0.49 (0.31–0.59)	2.30 (0.17–3.89)	2.94 (1.20–4.28)	0.99 (0.48–1.85)
Muscle	0.63 (0.42–0.85)	0.19 (0.16–0.25)	0.69(0.52–0.85)	2.29 (1.92–2.50)	0.33 (0.15–0.53)
Skin	< 0.05	2.02 (1.56–2.67)	6.39 (5.90–7.23)	21.58 (13.24–26.21)	2.94(1.83–3.84)
Fat	0.27 (0.25–0.29)	5.57 (5.49–5.76)	16.9 (15.14–19.22)	69.4 (59.04–77.40)	13.7 (7.95–19.56)

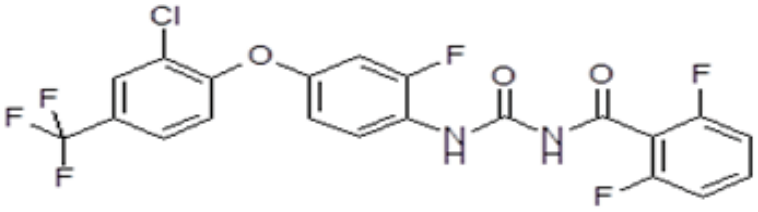
Table 49 Residues of Reg. No. 4064702 in liver

Mean (range) residues of Reg. No. 4064702 in Liver [mg/kg]				
Group A (Control)	Group B (1 mg/kg diet)	Group C (3 mg/kg diet)	Group D (10 mg/kg diet)	Group D Day 40 depuration
< 0.03	0.04 (< 0.02–0.04)	0.18 (0.054–0.37)	0.20 (0.10–0.36)	0.03 (0.028–0.036)

APPRAISAL

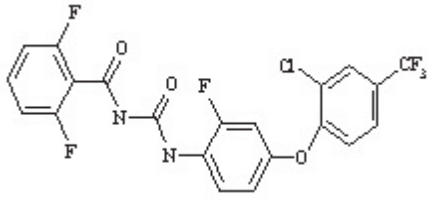
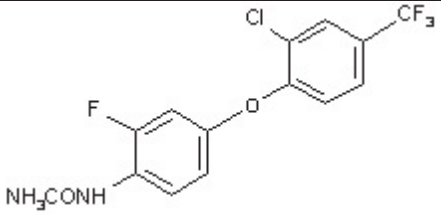
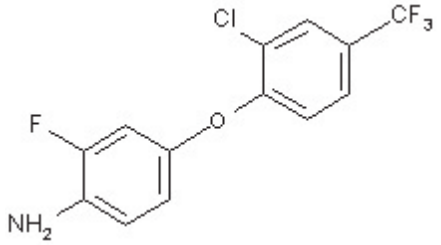
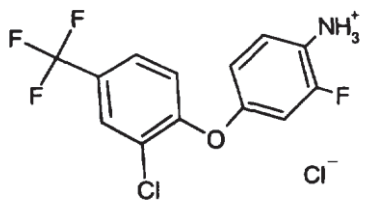
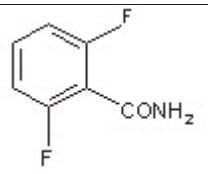
Flufenoxuron is a benzylurea insect growth regulator used to kill mites and insects, through interference with chitin production during cuticle development in mite and insect juvenile stages, on various orchard crops, fruiting vegetables and tea. It was considered for the first time by the 2014 JMPR for toxicology and residues.

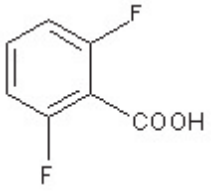
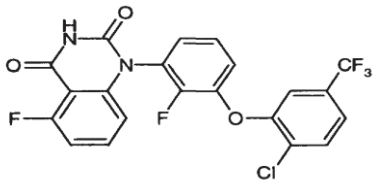
The Meeting received information on physical chemical properties, livestock and plant metabolism, environmental fate, analytical methods, storage stability, supervised residue trials, use patterns, processing and livestock feeding.



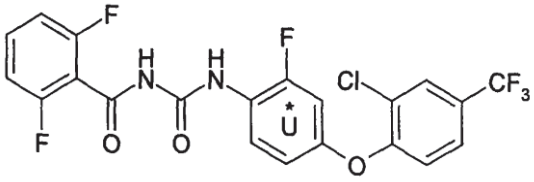
The IUPAC name of flufenoxuron is N-{4-[2-chloro-4-(trifluoromethyl)phenoxy]-2-fluorophenyl}-N'-(2,6-difluorobenzoyl)urea and the CA name is N-[[[4-[2-chloro-4-(trifluoromethyl)phenoxy]-2-fluorophenyl]amino]carbonyl]-2,6-difluorobenzamide.

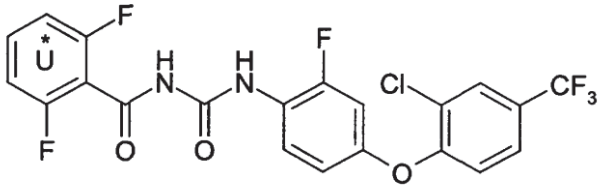
Common chemical names, code names and structures of the parent and metabolites are captured below:

Code	Structure	Occurrence
Flufenoxuron WL 115110		Rat Lactating goat Laying hen Grape Apple Tomato Chinese cabbage Soil Hydrolysis study
Reg. No. 4064702		Rat Laying hen Soil Hydrolysis study
Reg. No. 241208		Rat Laying hen Hydrolysis study
Reg. No. 4064703 (chloride salt of Reg. No. 241208)		Hydrolysis study
Reg. No. 102719		Rat Hydrolysis study

Code	Structure	Occurrence
Reg. No. 206925		Rat Hydrolysis study
Reg. No. 4964847		Hydrolysis study

Flufenoxuron uniformly labelled in either the fluoroaniline or difluoroamide rings was used in the metabolism and environmental fate studies.





Fluoroaniline U-^{14}C Difluoroamide U-^{14}C

Animal metabolism

Information was available on the metabolism of flufenoxuron in laboratory animals, lactating goats and laying hens.

Metabolism studies in rats demonstrated that unchanged flufenoxuron accounted for the majority of the total applied radioactivity (TAR) in faeces, with minor metabolites (less than 1% of the TAR) identified as 2-amino-5-(2-chloro-α,α,α-trifluoro-p-tolyoxy)-3-fluorophenol (Reg. No. 4110959), Reg. No. 4064702, Reg. No 241208, Reg. No 102719 and Reg. No. 206925. For organs and tissues, parent flufenoxuron was the main component observed.

In the lactating goat metabolism study, one goat received four daily doses of 2-fluoroaniline-[U-^{14}C]-ring-labelled flufenoxuron at a rate equivalent to 10 ppm in the diet (10 mg/day). The animal was sacrificed 24 hours after administration of the last dose. While the majority of the radioactivity was excreted via the faeces (18% of the TAR) and urine (2.5% of the TAR), milk and tissues accounted for ≤ 10% of the TAR. Total recovered radioactivity was low (33%). No explanation for the low recovery was evident.

The total radioactive residues (TRRs) were highest in fat (1.6 mg eq/kg), followed by liver (0.37 mg eq/kg), kidney (0.13 mg eq/kg) and muscle (0.076 to 0.1 mg eq/kg). Milk residues peaked on day 4 (average of 0.27 mg eq/L) with the highest concentrations of radioactivity detected in the cream fraction (accounting for 82–93% of the TRR in whole milk) and the lowest found in whey (1.3–5.7% of the TRR). Following solvent extraction, residue extractabilities were 66–100%.In milk

and all tissues sampled, the flufenoxuron molecule remained intact with no other metabolites being detected.

Two studies on metabolism in laying hens were available. In the first study, the laying hens received 14 daily doses of flufenoxuron, uniformly labelled in the difluoroamide or fluoroaniline rings, at 13–14 ppm in the feed. The animals were sacrificed approximately 23 h after the last dose. Excreta accounted for 72–78% of the TAR. No plateau was reached in eggs during the dosing period (14 days); however, the radioactivity in eggs and tissues amounted to 1.0–1.3% and 2.6–3.6% of the TAR, respectively. Among all the tissues analysed, radioactive residues were highest in fat (5.0–5.3 mg eq/kg) followed by liver (0.6–1.1 mg eq/kg) and muscle (0.3–0.4 mg eq/kg). The total recovery of radioactivity was 82% and 77% in the groups administered the difluoroamide- and fluoroaniline-labelled flufenoxuron, respectively.

Solvent extraction released 91–102% and 88–99% of the TRRs for the difluoroamide- and fluoroaniline-label, respectively. While the lowest extractability occurred in the liver of the fluoroaniline-labelled study (88% of the TRR), microwave extraction of the liver post-extraction solid (PES) sample released another 8% of the TRR. For the difluoroamide-label, the parent was the only analyte identified in eggs, muscle, fat and liver ranging from 0.28 mg eq/kg (86.5% of the TRR, muscle) to 4.6 mg eq/kg (91.4%, fat).

For the fluoroaniline-label, the parent compound accounted for the majority of the TRRs (70–91%) in the eggs, muscle, fat and liver. The lowest level of parent was found in muscle (0.30 mg eq/kg) with the highest observed in fat (4.8 mg eq/kg). In eggs and liver, Reg. No. 4064702 was present at 0.10 mg eq/kg and 0.13 mg eq/kg (12.0% and 12.6% of the TRR, respectively) while in muscle and fat, Reg. No. 4064702 was a minor metabolite amounting to 0.02 mg eq/kg and 0.05 mg/kg, respectively (5.5% and 1.0% of the TRR). The formate derivative of Reg. No. 241208 was released from the PES of liver after microwave treatment in the presence of formic acid/acetonitrile. The radioactivity associated with this derivative amounted to 0.04 mg eq/kg (3.3% TRR). The Meeting could not confirm whether the metabolite Reg. No. 241208 is an actual in-vivo metabolite or an artefact formed during microwave treatment.

In the second study, laying hens received seven consecutive daily doses of flufenoxuron uniformly labelled in the fluoroaniline ring at a rate equivalent to 10 ppm in the diet. Hens were sacrificed 22 hours following administration of the last dose. To investigate the depuration behaviour of flufenoxuron, four groups of three laying hens each were sacrificed at 2, 9, 16, and 34 days after the last administration.

On average, 26% of the TAR was excreta-related with eggs, sampled from 0–166 h after the first administration, accounting for 5% of the TAR. At sacrifice, the highest amount of radioactive residues was detected in fat (47% of the TAR), followed by skin (12% of the TAR), muscle (4% of the TAR), liver (2% of the TAR), kidney (0.3% of the TAR), heart and gizzard (combined 0.2% TAR). The recovery of radioactivity amounted to 96% of the TAR.

Solvent extraction (including incubation of liver and kidney samples at 37 °C) released 91–102% of the TRRs). The parent compound was the predominant analyte detected in yolks, liver, kidney, muscle, gizzard and heart while it was the only compound detected in fat and skin. The metabolite Reg. No. 4064702 was detected in yolks, liver, kidney, muscle, gizzard, and heart at 6–22% of the TRR, while the minor metabolite Reg. No. 241208 was only detected in liver and kidney at ≤ 4% of the TRR, the only matrices that were incubated for 16 hours at 37 °C in 0.07M phosphate buffer at pH 7.5 prior to extraction

In the depuration study, radioactivity in egg yolks decreased steadily from a mean of 0.02 mg eq./kg, 2 days after cessation of dosing to 0.006 mg eq.kg on depuration day 34. Similarly, radioactivity in muscle decreased from 0.28 mg eg/kg to 0.06 mg eq/kg, during this same interval In kidney and liver, the decrease in radioactivity was more prominent from day 16 to day 34 of the depuration phase (kidney; 0.48 mg eq/kg to 0.17 mg eq/kg and liver; 0.89 mg eq/kg to 0.42 mg eq/kg) yet in fat, the decrease in radioactivity occurred most rapidly from day 2 to day 9 (13.18 mg eq/kg to 6.00 mg eq/kg) and from day 16 to day 34 (4.6 mg eq/kg to 1.97 mg eq/kg). These results

demonstrate that radioactive residues are not retained in eggs, organs and tissues after cessation of dosing.

In both laying hen studies, the metabolic pattern was comparable with unchanged flufenoxuron accounting for the majority of the radioactivity, representing ≥ 60% of the TRRs in eggs and tissues. The minor metabolites Reg. No. 4064702 (eggs and tissues) and Reg. No. 241208 (liver and kidney), resulting from the cleavage of the benzoyl urea bond, were also observed to a limited extent (≤ 12% of the TRRs; except in the kidney where Reg. No. 4064702 represented 22% of the TRRs).

The Meeting concluded that in the lactating goat metabolism study, the parent flufenoxuron remained intact and was the only residue identified in milk and all tissues. In the laying hen metabolism studies, while flufenoxuron was the predominant residue in eggs and tissues, cleavage of the benzoyl urea bond was observed to a limited extent resulting in the formation of the metabolites Reg. No. 4064702 (eggs and tissues) and Reg. No. 241208 (liver and kidney).which were also identified in the rats.

Plant metabolism

The Meeting received metabolism studies for flufenoxuron following foliar applications of either [difluorobenzamide-U-^{14}C]- or 2-fluoroaniline-[U-^{14}C]-ring-flufenoxuron to grape, apple, tomato and Chinese cabbage.

Two foliar sprays were made to grape vines, grown outdoor and protected with plastic covers after application, during fruit development; at a rate of 0.04 kg ai/ha/application, with a 40-day retreatment interval, resulting in a total rate of 0.08 kg ai/ha. Immature leaves were collected at 15 DAT (days after last treatment) while mature leaves, stalks and fruit (from grape clusters) were harvested 28–29 DAT. TRRs in leaves declined from 2.3–2.7 mg eq/kg at 15 DAT to 1.4–1.8 mg eq/kg at 29 DAT. TRRs in mature fruit and stalks were 0.012–0.014 mg eq/kg and 0.11–0.16 mg eq/kg, respectively. Solvent extraction released approximately 95–97% of the TRR (0.012–2.6 mg eq/kg) from the grape matrices. Flufenoxuron was the only compound identified in all fruit, leaf and stalk samples (50–97% of the TRR; 0.007–2.2 mg eq/kg). Polar unknowns comprised up to 40–46% of the TRR in mature grape samples (0.005–0.006 mg eq/kg) with unextracted residues in all leaf, fruit and stalk samples accounting for ≤ 5% of the TRR (< 0.11 mg eq/kg).

Ten apple trees, maintained in glasshouses, were sprayed with flufenoxuron, uniformly labelled in the fluoroaniline ring. A single application of the dispersible concentrate was made to trees, during fruit development, at a rate of 0.01 kg ai/hL. Samples of immature fruit were harvested 0 days (4 h post-treatment) and 46 days after treatment (DAT), and mature fruit samples were collected at 99 DAT. TRRs in immature fruit were 2.6 mg eq/kg (0 DAT) and declined to 0.16 mg eq/kg (46 DAT) and 0.06 mg eq/kg (99 DAT). The radioactivity in the combined acetonitrile and hexane surface washes decreased with increasing DAT, from 96% of the TRRs at 0 DAT to 77% of the TRRs at 99 DAT, with a corresponding increase in TRRs in fruit extracts (3.7% TRR at 0 DAT to 23% of the TRRs at 99 DAT), demonstrating limited translocation. The parent flufenoxuron accounted for the majority of the TRRs in surface washes (74–93%; 0.043–2.4 mg eq/kg) and in fruit extracts (3–16% of the TRRs; (0.01–0.08 mg eq/kg).

A single broadcast foliar application of 2-fluoroaniline-[U-^{14}C]-ring-flufenoxuron, formulated as an emulsifiable concentrate, was made to tomato plants, maintained outdoor, during fruit development at a rate of 0.125 kg ai/ha. Tomato fruit was harvested at 0 and 28 DAT. TRRs in/on tomato fruit declined from 0.38 mg eq/kg on day 0, to 0.2 mg eq/kg by day 28. The total extracted residues (ACN:water surface washes and fruit extracts) from 0 DAT to 28 DAT, accounted for 94–99% of the TRR (0.16–0.38 mg eq/kg), mainly from the surface wash (≥ 94% of the TRRs). Flufenoxuron was the only identified residue in the mature tomato sample (91% of the TRRs).

2-Fluoroaniline-[U-^{14}C]-ring-flufenoxuron, formulated as an emulsifiable concentrate, was applied once to Chinese cabbage plants, grown outdoor, during leaf development, as a foliar application, at a rate equivalent to 0.10 kg ai/ha. Cabbage plants were harvested at 0 and 28 DAT.

TRRs in/on cabbage wrapper leaves declined from 6.3 mg eq/kg on day 0 to 0.35 mg eq/kg by day 28. At 0 DAT, the surface wash represented the majority of the extracted residues (84% of the TRRs; 5.3 mg eq/kg) while at the 28 DAT, the leaf extracts accounted for a greater fraction of the extractable radioactivity (76% of the TRRs; 0.27 mg eq/kg). The parent flufenoxuron was the only identified residue in mature cabbage leaves (93% of the TRRs).

The Meeting concluded that the metabolism of flufenoxuron in grape, apple, tomato and Chinese cabbage is consistent among all crops, where parent flufenoxuron remained intact. No other metabolites were identified and no other residues were characterized (other than polar unknowns). The Meeting agreed that the majority of radioactivity remained on the leaves or surface of the fruit, with limited translocation.

Environmental fate in soil

The Meeting received information on aerobic degradation in soil.

In these studies, the fluoroaniline-specific metabolite, Reg. No. 4064702, was the only metabolite identified, reaching a maximum concentration after 30 days of incubation (4.1–8.3% TAR). The predominant residue, flufenoxuron, decreased to 45.8–51.0% TAR in the soil after 119 days, resulting in a calculated DT_{50} for flufenoxuron of 115–122 days. Considering the persistence of flufenoxuron, it is desirable that confined rotational crop and field accumulation studies be submitted.

Methods of residue analysis

The Meeting received analytical methods for the analysis of flufenoxuron in plant and animal commodities. The basic principle for plant commodities employs extraction by homogenisation with dichloromethane, methanol/water/HCl or acetone followed by partitioning with water/cyclohexane. For animal matrices, flufenoxuron residues are extracted by homogenization with various non-polar organic solvents followed by liquid partitioning and/or clean-up by normal-phase or reverse-phase HPLC prior to analysis. Residues of flufenoxuron are measured by HPLC-MS/MS with two specific mass transitions or with HPLC-UV at 254–260 nm. The applicability of the proposed enforcement methods was confirmed in various independent laboratories where parent flufenoxuron was analysed with validated LOQs of 0.05 mg/kg for plant and animal commodities and eggs, and 0.01 mg/kg for milk.

The multiresidue method DFG S-19 was tested, for the analysis of flufenoxuron in animal matrices only, and found to be unsuitable.

A number of scientific papers report the validation of the QuEChERS multi-residue method using GC-MS/MS for flufenoxuron in various plant commodities.

The Meeting concluded that the available enforcement analytical methods are suitable for determining residues of flufenoxuron in plant and animal commodities with LOQs, ranging from 0.01–0.05 mg/kg depending on the matrix.

Stability of residues in stored analytical samples

Based on the storage stability data submitted, the Meeting concluded that no significant dissipation of flufenoxuron residues was observed in cottonseed, orange, grape, and apple after 36 months of storage, in lettuce after 27 months and in watermelon (pulp and peel) after 26 months.

The Meeting agreed that no degradation of flufenoxuron residues was observed in animal matrices stored for up to 53 months of storage, except egg whites, where flufenoxuron residues were determined to be stable for up to 4 months.

Definition of the Residue

In the lactating goat metabolism study, flufenoxuron was the only residue identified in tissues and milk with no other metabolites detected. Similarly, in the laying hen metabolism studies, flufenoxuron

accounted for the majority of the radioactivity in eggs, muscle, fat, liver and kidney (60–104% of the TRRs).

Therefore, the Meeting recommends the residue definition for compliance with MRL for animal commodities as flufenoxuron.

The Log K_{ow} of flufenoxuron is 4. In the goat metabolism study, highest levels of the parent compound were observed in fat and cream, while in the laying hen metabolism studies, the highest concentrations of flufenoxuron were observed in the fat (≤ 98% of the TRRs). These findings were supported by the livestock feeding studies, where the average ratio for cream/skim milk was ≥ 155 and ≥ 112 for egg yolks/egg whites. Further to this, residues in fat were 24–30-fold higher than those in muscle.

In light of this, the Meeting concluded that the residue is fat soluble.

The metabolite Reg. No. 4064702 was also identified in laying hen muscle, fat, liver, kidney and eggs (1–22% of the TRRs) with the highest levels observed in liver and kidney. The minor metabolite Reg. No. 241208 was also observed but only in liver and kidney (2.5–3.7% of the TRRs) which were the only matrices that were subject to microwave extraction (liver only) or incubation at 37 °C in 0.07M phosphate buffer at pH 7.5 prior to extraction (liver and kidney), and hence considered a potential artefact of the analytical procedure.

The toxicity of the minor metabolite Reg. No. 241208, found in laying hen matrices, was considered to be covered by toxicity studies on flufenoxuron since this metabolite was seen in the rat. The metabolite Reg. No. 4064702, also observed in eggs and tissues of laying hens, and observed in the rat, was determined to be more acutely toxic than the parent flufenoxuron based on the LD_{50}. However, according to the poultry feeding study, residues of this metabolite in liver are not expected to exceed 0.04 mg/kg at the lowest feeding level of 1 ppm. Hence, as there are no poultry feed items derived from the proposed crops, the dietary exposure to this metabolite from poultry matrices is unlikely.

The Meeting recommends the residue for dietary intake for animal commodities as parent only.

The fate of flufenoxuron in plants was investigated following foliar application to tomato, apple, grape and Chinese cabbage. In all plant commodities tested, flufenoxuron was the predominant residue accounting for > 90% of the TRR, with the exception of grape, where flufenoxuron accounted for 50% of the TRR. No other metabolites were identified and no other residues were characterized (other than polar unknowns).

According to the hydrolysis study, simulating typical processing conditions (pH 4, 5 and 6 with 90 °C, 100 °C and 120 °C for 20, 60 and 20 minutes), flufenoxuron was degraded to various metabolites including: Reg. No. 102719 (8–32%), Reg. No. 4064702 (4%) and Reg. No. 4964847 (4–9%). All metabolites, except Reg. No. 4064702 and Reg. No. 4964847 are considered to be covered by toxicity studies on flufenoxuron, since they were seen in the rat. The absorption, distribution, metabolism and excretion studies in rat demonstrated that Reg. No. 4064702 was more acutely toxic than the parent flufenoxuron. Conversely, no toxicity information is available on metabolite Reg. No. 4964847, Reg. No. 4064702. Nevertheless, in the tomato processing study where these metabolites were measured in juice, purée and canned tomatoes, none were detected (< 0.01 mg/kg)

The Meeting recommended the following residue definition for flufenoxuron:

Definition of the residue for compliance with MRL and for estimation of dietary intake for plants and animal commodities: *flufenoxuron*

The Meeting considers the residue fat soluble.

Results of supervised residue trials on crops

The Meeting received supervised residue trials from Brazil, Europe and South Africa where flufenoxuron was applied to oranges, apples, pears, melons and tomatoes and Japanese trials on tea.

Oranges

The critical GAP in Brazil for flufenoxuron on oranges is up to two foliar applications of 0.005 kg ai/hL, with a re-treatment interval of 30 days and a PHI of 15 days. Sixteen supervised field trials were conducted in Greece, Italy, South Africa and Brazil.

Four of the trials were conducted in Brazil according to the critical GAP. Residues in whole oranges at the 15-day PHI were: 0.09, 0.11, 0.13 and 0.16 mg/kg.

Five trials in Brazil were conducted at 2× 0.002–0.003 kg ai/hL with a PHI of 15 days, representing 0.4–0.6× the critical GAP in Brazil. The residues in whole fruit were 0.03, 0.05, 0.07, 0.08 and 0.10 mg/kg. The Meeting agreed to use the proportionality approach to scale the residues at the 15-day PHI according to an application rate of 0.005 kg ai/hL. The rank order of scaled residues in whole fruit was (n = 5): 0.08 (2), 0.13 (2), and 0.17 mg/kg.

When combining all the residue data, residues in whole oranges were 0.08 (2), 0.09, 0.11, 0.13 (3), 0.16 and 0.17 mg/kg and residues in pulp were 0.03, 0.04, 0.05 (3), 0.06, 0.08 (2) and 0.10 mg/kg.

The Meeting estimated a maximum residue level of 0.4 mg/kg, and a median residue of 0.13 mg/kg for residues of flufenoxuron in whole oranges. For orange pulp, the Meeting estimated an STMR of 0.05 mg/kg.

Apples

The Brazil critical GAP for flufenoxuron on apples is a single foliar application at 0.01 kg ai/hL and a PHI of 35 days.

Three trials on apples were available from Chile where trees were treated at 0.015–0.02 kg ai/hL with PHIs of 35–36 days, representing 1.5–2× the critical GAP in Brazil. The residues in the fruit were 0.17, 0.43 and 0.52 mg/kg. The Meeting agreed to use the proportionality approach to scale the residues at the PHIs of 35–36 days according to the application rate of 0.01 kg ai/hL. The ranked order of the scaled residues were: 0.08, 0.22 and 0.35 mg/kg (n=3).

In two trials conducted in Chile in accordance with Brazilian GAP, flufenoxuron residues were 0.07 and 0.45 mg/kg.

The Meeting concluded that the number of trials available was insufficient to estimate a maximum residue level for residues of flufenoxuron in apples.

Melons

There is no GAP in Brazil for flufenoxuron on melons; therefore, the Meeting could not recommend a maximum residue level.

Tomatoes

There is no GAP in Brazil for flufenoxuron on tomatoes; therefore, the Meeting could not recommend a maximum residue level.

Tea

The critical GAP for flufenoxuron in Japan for tea is up to two foliar applications of 0.025 kg ai/hL at a re-treatment interval of 7–14 days and a PHI of 7 days.

In seven of the eleven trials conducted in Japan and matching the critical GAP, residue levels in tea (green) were: 2.37, 2.48, 3.95, 4.58, 6.02, 6.23 and 11.8 mg/kg.

The Meeting estimated a maximum residue level of 20 mg/kg and a STMR of 4.58 mg/kg for residues of flufenoxuron in tea, green, black (black, fermented and dried).

Fate of residues during processing

Nature of residues

The Meeting received information on the hydrolysis of flufenoxuron uniformly labelled in the fluoroaniline and difluoroamide rings where typical processing conditions were simulated (pH 4,5 and 6 with 90 °C, 100 °C and 120 °C for 20, 60 and 20 minutes).

In duplicate samples of sterile buffer solution flufenoxuron (accounting for 63–93% of the TAR) was seen to hydrolyse to various metabolites, however, none accounted for greater than 10%of the TAR, with the exception of Reg. No. 102719, present at 32% of the TAR, following hydrolysis conditions simulating baking, boiling and brewing procedures.

Level of residues

The Meeting also received information on the fate of flufenoxuron residues during the processing of the raw agricultural commodities like tomato to juice, pomace, puree and canned tomatoes and tea to infusion. While the magnitude of the residues of Reg. No. 102719in tea infusion was not elucidated, in the tomato processing study, the residues of flufenoxuron metabolites, including Reg. No. 102719, Reg. No. 4064702 and Reg. No. 4964847 in all processed tomato commodities were below the LOQ (0.01 mg/kg). However, in the absence of a critical GAP in Brazil for flufenoxuron on tomatoes, the tomato processing study was not relied upon to derive processing factors, STMR-P values and to estimate maximum residue levels for tomato processed commodities.

The processing factor obtained in the tea processing study and the estimated STMR-P value for the dietary intake calculation is summarized below:

Raw agricultural commodity	STMR, mg/kg	Processed commodity (food)	Processing factor	STMR-P (mg/kg)
Tea (green)	6.02	Infusion	0.0065 (median)	0.04

Residues in animal commodities

Farm animal feeding studies

The Meeting received information on the residue levels arising in animal tissues and milk when dairy cows were fed flufenoxuron for 90 days at levels equivalent of 1.75, 5.25 and 17.5 ppm in the diet. Three animals from the highest dose level group were monitored for flufenoxuron residues over a 40-day depuration phase.

At the lowest dose tested, flufenoxuron residues in milk increased steadily over the 90-day period, from 0.0243 mg/kg on day 2 to 0.64 mg/kg on day 90, however, in the mid and high dose groups, residues seemed to plateau on day 56 (at 1.6 mg/kg) and day 70 (at 5.5 mg/kg), respectively. Analysis of milk obtained from the high dose group showed that pasteurization had no effect on the levels of flufenoxuron in milk. Residues in cream were concentrated by a factor of 1.5. In skimmed milk and acid whey, residues were lower than those of raw milk.

In all tissues tested, except subcutaneous fat, residues of flufenoxuron were dose dependant, increasing with increasing dose. In subcutaneous fat, residues were 0.8 mg/kg, 9.3 mg/kg and 8.7 mg/kg, in the low, mid and high dose groups, respectively.

The residue depuration study demonstrated that flufenoxuron residues in milk decreased slowly within the 40 days of cessation of dosing, from 5.1 mg/kg on day 91 to 0.9 mg/kg on day 130. In tissues, flufenoxuron residues decreased on average by 80% by day 130.

The Meeting also received information on the residues in tissues and eggs of laying hens when dosed with flufenoxuron for 50 days at levels equivalent to 1, 3, 10 ppm in the diet. Fifteen animals from the top dose group were monitored for flufenoxuron residues over a 40-day depuration phase.

At all feeding levels, no residues of flufenoxuron in egg white exceeded 0.05 mg/kg. However, residues in egg yolks did not reach a plateau but rather increased steadily over the 50-day period.

Residues of flufenoxuron in liver, muscle, skin and fat increased with increasing feeding level.

During the depuration study, flufenoxuron residues in egg yolks decreased more rapidly than in cattle milk over the same duration, from 32.5 mg/kg on day 51 to 2.3 mg/kg on day 90.

Farm animal dietary burden

As there is no information on citrus dry pulp, the only potential cattle feed item derived from the proposed crops and there are no poultry feed items, the Meeting did not calculate farm animal dietary burdens.

Therefore, the Meeting estimated maximum residue levels of 0.05* mg/kg for flufenoxuron in meat (from mammals other than marine mammals), edible offal (mammalian), mammalian fat (except milk fats) and 0.01* mg/kg for milks. STMRs and HRs for dietary intake estimation are 0 mg/kg for meat (from mammals other than marine mammals), edible offal (mammalian), mammalian fat (except milk fats) and milks.

The Meeting did not estimate maximum residue levels, STMRs or HRs for poultry matrices.

The residue in animal commodities is considered fat soluble.

RECOMMENDATIONS

On the basis of the data from supervised trials, the Meeting concluded that the residue levels listed below are suitable for establishing maximum residue limits and for IEDI assessment.

Definition of the residue (for compliance with the MRL and for estimation of dietary intake, animal and plant commodities): *flufenoxuron*

The residue is fat soluble.

CCN	Commodity Name	MRL mg/kg	STMR or STMR-P mg/kg	HR or HR-P mg/kg
FC 0004	Oranges, Sweet, Sour	0.4	0.13	–
	Orange pulp	–	0.05	–
DT 1114	Tea, Green, Black (black, fermented and dried)	20	4.58	–
	Tea infusion	–	0.04	–
MO 0105	Edible offal (mammalian)	0.05*	0	–
MM0095	Meat (from mammals other than marine mammals)	0.05*	0	–
MF 0100	Mammalian fats (except milk fats)	0.05*	0	–
ML 0106	Milks	0.01*	0	–

DIETARY RISK ASSESSMENT

Long-term intake

The International Estimated Daily Intake (IEDI) for flufenoxuron was calculated based on the recommendation for STMRs for raw and processed commodities (tea infusion) in combination with consumption data for corresponding food commodities. These results are shown in Annexe 3.

The IEDI of the 17 GEMS/Food cluster diets, based on the estimated STMRs represented 0% of the maximum ADI of 0.04 mg/kg bw, expressed as flufenoxuron. The Meeting concluded that the

long-term intake of flufenoxuron residues from uses considered by the Meeting is unlikely to present a public health concern.

Short-term intake

No ARfD was considered necessary. The Meeting concluded that the short-term intake of flufenoxuron residues from uses considered by the Meeting is unlikely to present a public health concern.

REFERENCES

Code	Author (s)	Year	Title, Institute, Report reference
FX-303-002	Camilleri, P *et al.*	1986 a	Melting point and differential thermal analysis of WL115110, Shell Research Ltd., Sittingbourne Kent ME9 8AG, United Kingdom, Unpublished
2001/1019524	Kaestel, R	2001 a	Density determination of the technical material of Flufenoxuron, BASF AG Agrarzentrum Limburgerhof, Limburgerhof, Germany Fed.Rep., Unpublished
FX-390-025	Rice, P	2000 a	Flufenoxuron (BAS 307 I): Calculation of Henry law constant, BASF Corp. Agro Research, Princeton NJ, United States of America, Unpublished
2001/1009097	Kaestel, R	2001 b	Physical properties of Flufenoxuron (PAI), BASF AG Agrarzentrum Limburgerhof, Limburgerhof, Germany Fed.Rep., Unpublished
2001/1009099	Kaestel, R	2001 c	Physical properties of Flufenoxuron (TC), BASF AG Agrarzentrum Limburgerhof, Limburgerhof, Germany Fed.Rep., Unpublished
FX-301-002	Langner, EJ	1988 a	Physico-chemical properties of WL115110, Shell Research Ltd., Sittingbourne Kent ME9 8AG, United Kingdom, Unpublished
FX-311-002	Camilleri, P, Langner, EJ and	1986 a	Solubility and pKa of WL115110 in water, Shell Research Ltd., Sittingbourne Kent ME9 8AG, United Kingdom, Unpublished
2001/1017469	Daum, A	2001 a	Determination of the solubility in organic solvents of BAS 307 I (Flufenoxuron, Reg.No. 243 154 TGAI (identical with CL 811 678)), BASF AG Agrarzentrum Limburgerhof, Limburgerhof, Germany Fed.Rep., Unpublished
2003/1000986	Hassink, J	2003 a	Aqueous photolysis of BAS 307 I, BASF AG Agrarzentrum Limburgerhof, Limburgerhof, Germany Fed.Rep., Unpublished
FX-330-001	Van Helvoirt, JAMW	1990 a	Determination of the flammability of Flufenoxuron, RCC Notox BV, s-Hertogenbosch, Netherlands, Unpublished
FX-330-002	Van Helvoirt, JAMW	1990 b	Determination of the auto-flammability of Flufenoxuron, RCC Notox BV, s-Hertogenbosch, Netherlands, Unpublished
FX-334-001	Van Helvoirt, JAMW and Cardinaals, JM	1990 a	Determination of the explosive properties of Flufenoxuron, RCC Notox BV, s-Hertogenbosch, Netherlands, Unpublished
FX-356-001	Van Helvoirt, JAMW	1990 c	Determination of the oxidizing properties of Flufenoxuron RCC Notox BV, s-Hertogenbosch, Netherlands, Unpublished
FX-440-008	Cameron, BD *et al.*	1987 a	The disposition of ^{14}C-WL115110 in the lactating goat and the identification of radioactive residues in selected tissues following multiple oral administration, IRI—Inveresk Research International Ltd., Musselburgh East Lothian EH21 7UB, United Kingdom, Unpublished

Code	Author (s)	Year	Title, Institute, Report reference
2003/1004084	Grosshans, F	2003 a	The metabolism of ^{14}C-BAS 307 I (Flufenoxuron) in laying hens. BASF AG Agrarzentrum Limburgerhof, Limburgerhof, Germany Fed.Rep., Unpublished
FX-440-015	Van Dijk, A	1991 a	^{14}C-WL115110: Absorption, distribution, metabolism and excretion after repeated oral administration to laying hens, RCC Umweltchemie AG, Itingen, Switzerland, Unpublished
2002/1011266	Leibold, E and Ravenzwaay, B van	2002 a	^{14}C-BAS 307 I (Flufenoxuron)—Absorption, distribution and excretion after repeated oral administration in laying hens. BASF AG, Ludwigshafen/Rhein, Germany Fed.Rep., Unpublished
FX-440-008	Cameron, BD *et al.*	1987 a	The disposition of ^{14}C-WL115110 in the lactating goat and the identification of radioactive residues in selected tissues following multiple oral administration. IRI—Inveresk Research International Ltd., Musselburgh East Lothian EH21 7UB, United Kingdom, Unpublished
2003/1004084	Grosshans, F	2003 a	The metabolism of ^{14}C-BAS 307 I (Flufenoxuron) in laying hens. BASF AG Agrarzentrum Limburgerhof, Limburgerhof, Germany Fed.Rep. Unpublished
FX-440-015	Van Dijk, A	1991 a	^{14}C-WL115110: Absorption, distribution, metabolism and excretion after repeated oral administration to laying hens RCC Umweltchemie AG, Itingen, Switzerland, Unpublished
2002/1011266	Leibold, E and Ravenzwaay, B van	2002 a	^{14}C-BAS 307 I (Flufenoxuron)—Absorption, distribution and excretion after repeated oral administration in laying hens. BASF AG, Ludwigshafen/Rhein, Germany Fed.Rep., Unpublished
2003/1004676	Veit, P and Bingemann, R	2003 a	Metabolism of ^{14}C-BAS 307 I in grape-vine BASF AG Agrarzentrum Limburgerhof, Limburgerhof, Germany Fed.Rep., Unpublished
FX-640-003	Edwards, VT	1987 a	The metabolism of ^{14}C-WL115110 in tomatoes Shell Research Ltd., Sittingbourne Kent ME9 8AG, United Kingdom, Study was conducted prior to the implementation of GLP certificates. Unpublished
FX-640-005	Edwards, VT	1991 a	Addendum to SBGR.87.066: The metabolism of ^{14}C-WL115110 in tomatoes. Shell Research Ltd., Sittingbourne Kent ME9 8AG, United Kingdom, Unpublished
FX-640-002	Edwards, VT	1987 b	The metabolism of ^{14}C-WL115110 in Chinese cabbage Shell Research Ltd., Sittingbourne Kent ME9 8AG, United Kingdom. Study was conducted prior to the implementation of GLP certificates, Unpublished
FX-620-039	Goodyear, A and Gross, R	2001 a	^{14}C-Flufenoxuron (BAS 307 I): Aerobic soil rate of degradation in three soils Covance Laboratories Ltd., Harrogate North Yorkshire HG3 1PY, United Kingdom, , Unpublished
2003/1005435	Stephan, A and Ebert, D	2003 a	Degradation rates of BAS 307 I (Flufenoxuron) and Reg.No. 406 4702 (CL932338) under aerobic conditions in different soils (DT_{50}/DT_{90}). BASF AG Agrarzentrum Limburgerhof, Limburgerhof, Germany Fed.Rep., Unpublished
2010/1051669	Class, T and Goecer, M	2010 a	Flufenoxuron: Development and validation of an analytical method for the determination and confirmation of BAS 307 I (Flufenoxuron) and its degradates in four crop types (apple, citrus, soybean, cereal grain). PTRL Europe GmbH, Ulm, Germany Fed.Rep., Unpublished
2003/1004358	Smalley, R	2003 a	Validation of LC/MS/MS method RLA 126765 for the analysis of BAS 307 I in grapes, green plant material, tomatoes and tomato processing commodities BASF plc, Gosport Hampshire PO13 0AU, United Kingdom, Unpublished
2004/1000759	Schulz, H	2004 a	Determination of Flufenoxuron (Reg.No. 243 154) in plant matrices—Independent laboratory validation of the method RLA 12675. Institut

Code	Author (s)	Year	Title, Institute, Report reference
			Fresenius Chemische und Biologische Laboratorien AG, Taunusstein, Germany Fed.Rep., Unpublished
2008/7012012	Saha, M	2008	**I**ndependent laboratory method validation of BASF Analytical method RLA 12675 "LC/MS/MS method for the determination of BAS 307 I (Flufenoxuron) Residues in Grapes, Green Plant material, Tomatoes and Tomato Processing Commodities" using Orange and Melon BASF Agricultural Research Center, 26 Davis Drive, Research Triangle Park, NC 27709, USA, Unpublished
FX-790-025	Anonymous	unspecified a	Japanese residue method—Determination of Flufenoxuron residues in tea leaves, Unpublished
FX-790-026	Anonymous	unspecified b	Japanese residue method—Determination of Flufenoxuron residues in infused tea, Unpublished
2008/1042807	Marin, JE	2008 a	Independent laboratory method validation of the analytical method for Flufenoxuron in green tea, PTRL West Inc., Hercules CA, United States of America, Unpublished
2002/5004112	Steinhauer, S	2002 a	BAS 307 I (Flufenoxuron): Determination of residue of Flufenoxuron in milk, meat and egg—validation of DFG method S 19 (Extended Revision), Dr. Specht & Partner Chemische Laboratorien GmbH, Hamburg, Germany Fed.Rep., Unpublished
FX-245-002	Anonymous	1989 a	Determination of residues of Flufenoxuron (WL115110: Cascade) in animal tissues—Liquid chromatographic method Shell Research Ltd., Sittingbourne Kent ME9 8AG, United Kingdom, Unpublished
FX-245-010	Anonymous	1987 a	Determination of residues of WL115110 (CASCADE) in animal tissues—Liquid chromatographic method Shell Research Ltd., Sittingbourne Kent ME9 8AG, United Kingdom, Unpublished
FX-245-006	Anonymous	1989 b	The determination of WL115110 (Cascade) in blood by high performance liquid chromatography, Shell Internationale Petroleum Maatschappij BV, The Hague, Netherlands, Unpublished
FX-245-003	Anonymous	1987 b	Determination of residues of WL115110 (Cascade) in animal fat—Liquid chromatographic method, Shell Research Ltd., Sittingbourne Kent ME9 8AG, United Kingdom, Unpublished
FX-245-009	Skorczynski, S	1997 a	CL 811,678: Independent laboratory validation of HPLC method SAMS 458-1 for the determination of CL 811,678 (Cascade, WL115110) residues in cattle fat by Centre Analytical Laboratories, Inc. Centre Analytical Laboratories Inc., State College PA, United States of America, Unpublished
FX-245-004	Anonymous	1989 c	Determination of residues of Flufenoxuron (WL115110: Cascade) in milk - Liquid chromatographic method Shell Research Ltd., Sittingbourne Kent ME9 8AG, United Kingdom. Unpublished
FX-245-008	Skorczynski, S	1997 b	CL 811,678: Independent laboratory validation HPLC method SAMS 486-1 for the determination of CL 811,678 (Cascade, WL115110) residues in raw whole milk by Centre Analytical Laboratories, Inc. Centre Analytical Laboratories Inc., State College PA, United States of America, Unpublished
FX-245-005	Anonymous	1989 d	Determination of residues of Flufenoxuron (WL115110: Cascade) in eggs—Liquid chromatographic method. Shell Research Ltd., Sittingbourne Kent ME9 8AG, United Kingdom, Unpublished
FX-326-004	Gillard, DF	1993 a	Freezer storage stability of Flufenoxuron (Cascade) in cottonseed, orange, grape and apple. Huntingdon Analytical Services, Middleport NY, United States of America, Unpublished
2000/1021958	Edwards, J	2000 a	Flufenoxuron freezer stability in lettuces. Cyanamid Agriculture Ltd., Gosport Hampshire PO13 0AS, United Kingdom, Unpublished

Code	Author (s)	Year	Title, Institute, Report reference
FX-726-003	Farrell, KJ	1996 a	Flufenoxuron: Residue study on lettuce—Decline curve Cyanamid UK Ltd., Gosport Hampshire PO13 0AS, United Kingdom, Unpublished
FX-726-005	Cronin, JA	1998 a	Flufenoxuron (CL 811678) 100 g ai/L DC (CF 80008): At harvest residue study on Flufenoxuron in lettuces (Spain, 1997). Cyanamid Agriculture Ltd., Gosport Hampshire PO13 0AS, United Kingdom, Unpublished
2000/1021961	Edwards, J	2000 b	Flufenoxuron freezer stability in watermelon peel Cyanamid Agriculture Ltd., Gosport Hampshire PO13 0AS, United Kingdom, Unpublished
2000/1021962	Edwards, J	2000 c	Flufenoxuron freezer stability in watermelon flesh Cyanamid Agriculture Ltd., Gosport Hampshire PO13 0AS, United Kingdom, Unpublished
2013/3006541	Ferreira, M	2013	Investigation of the storage stability of CL 932338, CL 359882 and CL 211558 residues in tomato (fruits) at -20 °C, Unpublished
2014/3000961	Ferreira, M	2013	Investigation of the storage stability of CL 932338, CL 359882 and CL 211558 residues in citrus (fruits) at -20 °C, Unpublished
FX-326-003	Lewis, CJ	1993 a	Flufenoxuron: Evaluation of stability under deep-freeze storage conditions. Hazleton UK, Harrogate North Yorkshire HG3 1PY, United Kingdom. Unpublished
FX-710-001	Gill, J *et al.*	1986 a	Residues of WL115110 in oranges from Brazil. Shell Research Ltd., Sittingbourne Kent ME9 8AG, United Kingdom, Unpublished
FX-710-008	Young, H	1997 a	Flufenoxuron (CL 811678) 100 g ai/L DC (DF 80008): At harvest residue study on Flufenoxuron in oranges (Greece 1996). Cyanamid Agriculture Ltd., Gosport Hampshire PO13 0AS, United Kingdom, Unpublished
FX-710-011	Young, H	1997 b	Flufenoxuron (CL 811678) 50 g ai/L DC (DF 80002): Decline curve residue study on Flufenoxuron in oranges (Italy 1996). Cyanamid Agriculture Ltd., Gosport Hampshire PO13 0AS, United Kingdom, Unpublished
2008/1037621	Dantas, C	2008 a	Study on the residues behavior of Flufenoxuron in citrus (whole fruit) after treatment with BAS 307 13 I, under filed conditions in Brazil GENCS—Global Environmental and Consumer Safety Laboratory, Guaratingueta, Brazil, Unpublished
2011/3008283	Dantas, C	2013	Residue Study of Flufenoxuron in Citrus (fruit) after treatment with BAS 307 13 I, under field conditions in Brazil GENCS—Global Environmental and Consumer Safety Laboratory, Guaratingueta, Brazil, Unpublished
FX-711-015	Freeman, J	1989 a	Certificate of analysis—The determination of Cascade (WL115110) residues in apples from Chile Hazleton UK, Harrogate North Yorkshire HG3 1PY, United Kingdom, Not subject to GLP regulations, Unpublished
FX-711-028	Lopez, AM	1990 a	Residues of Cascade (Flufenoxuron)—Tests on pears, peaches, nectarines, plums and apples, No, not subject to GLP regulations. Unpublished
2010/1022761	Dantas, C and Marinho, E	2010 a	Study of residues of Flufenoxuron in melon (fruits) after treatment with BAS 307 13 I under field conditions in Brazil for import tolerance. BASF SA, Guaratingueta, Brazil, Unpublished
2008/103762	Dantas, C	2008 a	Study on the residues behaviour of Flufenoxuron in melon (peel and

Code	Author (s)	Year	Title, Institute, Report reference
2			pulp) after treatment with BAS 307 13 I, under field conditions in Brazil GENCS—Global Environmental and Consumer Safety Laboratory, Guaratingueta, Brazil, Unpublished
2014/3000941	Dantas, C	2014	Residue Study of Flufenoxuron in Melon (whole fruit, peel and pulp) after treatment with BAS 307 13 I, under field conditions in Brazil. GENCS—Global Environmental and Consumer Safety Laboratory, Guaratingueta, Brazil, Unpublished
2008/1037022	North, L	2008 a	Study on the residue behaviour of Flufenoxuron in protected tomato after treatment with BAS 307 13 I under field conditions in Southern Europe during 2007 (2007–2008) Agrisearch UK Ltd., Melbourne Derbyshire DE73 8AG, United Kingdom, Unpublished
2008/3002301	Dantas, C	2008 c	Study of residues of Flufenoxuron in tomato (fruit) after treatment with BAS 307 13 I, under field conditions in Brazil BASF SA, Guaratingueta, Brazil, Unpublished
2011/1050092	Dantas ,C *et al.*	2011 a	Estudo de residuos de Flufenoxuron em tomate (frutos), apos tratamento com BAS 307 13 I, em condicoes de campo no Brasil. BASF SA, Guaratingueta, Brazil, Unpublished
2011/3007023	Dantas, C *et al.*	2011	Residue Study of Flufenoxuron in Tomato (fruit) after treatment with BAS 307 13 I under field conditions in Brazil BASF SA, Guaratingueta, Brazil, Unpublished
2005/1026233	Weber, S	2005 a	Investigation of the residue behaviour of BAS 307 I (Flufenoxuron) in green tea. BASF AG Agrarzentrum Limburgerhof, Limburgerhof, Germany Fed.Rep., Unpublished
2007/1054407	Class, T	2007 a	Flufenoxuron: Investigation of the residue behavior of BAS 307 I and its degradates in green tea PTRL Europe GmbH, Ulm, Germany Fed.Rep., Unpublished
2003/1033819	Tanaka, Y and Yabusaki, T	2003 a	Residue determination of Flufenoxuron in or on Japanese green tea treated with Flufenoxuron 10% emulsifiable concentrate at 25 ppm (ai)—Analysis of crude tea and its infusion solution Japan Food Research Laboratories, Tama-shi Tokyo 206-0025, Japan, Unpublished
2003/1000985	Hassink, J	2003 a	Hydrolysis of BAS 307 I at 90 °C, 100 °C and 120 °C BASF AG Agrarzentrum Limburgerhof, Limburgerhof, Germany Fed.Rep., Unpublished
FX-710-005	Viljoen, AJ	1989 a	Determination of Flufenoxuron residues in oranges SABS—Suid-Afrikaanse Buro vir Standaarde, Pretoria, South Africa Rep. ,Unpublished
FX-710-001	Gill, J *et al.*	1986 a	Residues of WL115110 in oranges from Brazil Shell Research Ltd., Sittingbourne Kent ME9 8AG, United Kingdom. Unpublished
FX-710-008	Young, H	1997 a	Flufenoxuron (CL 811678) 100 g ai/L DC (DF 80008): At harvest residue study on Flufenoxuron in oranges (Greece 1996). Cyanamid Agriculture Ltd., Gosport Hampshire PO13 0AS, United Kingdom, Unpublished
FX-710-011	Young, H	1997 b	Flufenoxuron (CL 811678) 50 g ai/L DC (DF 80002): Decline curve residue study on Flufenoxuron in oranges (Italy 1996). Cyanamid Agriculture Ltd., Gosport Hampshire PO13 0AS, United Kingdom, Unpublished
2008/1037622	Dantas, C	2008 a	Study on the residues behaviour of Flufenoxuron in melon (peel and pulp) after treatment with BAS 307 13 I, under field conditions in Brazil. GENCS—Global Environmental and Consumer Safety Laboratory, Guaratingueta, Brazil, Unpublished

Code	**Author (s)**	**Year**	**Title, Institute, Report reference**
2003/1004346	Smalley, R	2003 a	Processing study on the residue behaviour of BAS 307 I in field tomatoes after application of BAS 307 QA I under field conditions in France (S) and Spain, 2001. BASF plc, Gosport Hampshire PO13 0AU, United Kingdom, Unpublished
2013/1045162	Ertus, C	2013 a	Determination of Flufenoxuron and its 6 processing products residues in tomatoes RAC and in processed fractions following treatments with BAS 307 13 I in Southern Europe in 2012—Final report No. R B2014, Unpublished
2007/1054407	Class, T	2007 a	Flufenoxuron: Investigation of the residue behavior of BAS 307 I and its degradates in green tea PTRL Europe GmbH, Ulm, Germany Fed.Rep., Unpublished
FX-705-006	Ullmann, L *et al.*	1993 a	Residues in eggs and tissues of laying hens arising by oral gavage of the test compound Flufenoxuron (WL 115 110) RCC—Research & Consulting Co. Ltd., Itingen, Switzerland, Unpublished
FX-705-005	Gill, JP and Pack, SE	1993 a	Flufenoxuron: Residues in milk, milk products and tissues of dairy cows arising from consumption of diet containing test compound. Shell Research Ltd., Sittingbourne Kent ME9 8AG, United Kingdom. Unpublished