IMIDACLOPRID (206)

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EXPLANATION

Imidacloprid was evaluated by the JMPR in 2001 for toxicology and in 2002 and 2006 for residues. It was scheduled by the 39th session of the CCPR for residue evaluation of additional crops. Imidacloprid is a neonicotinoid insecticide and used on a number of crops for the control of many insect pests such as aphids, thrips, whiteflies and leafhoppers.

The Interregional Research Project No. 4 (IR-4) in the USA provided residue data for avocadoes, bananas, blueberries, caneberries, carrots, coffee, peas, peanuts, pomegranates, radishes, strawberries, sugar apples, sunflowers and tree nuts. Japan supplied information on use patterns of imidacloprid applications on some crops and the manufacturer provided labels of products registered in the USA.

METHODS OF RESIDUE ANALYSIS

The residue definition of imidacloprid was determined by the 2002 meeting of the JMPR as "the sum of imidacloprid and its metabolites containing the 6-chloronicotinyl moiety, expressed as imidacloprid".

Analytical methods

Samples from all supervised trials were analysed for combined residues of imidacloprid and its metabolites by a reference method, Bayer Method 00200 reformatted (report No 102624 R1, 2/23/94), or with minor modifications in some trials. There were four metabolites of imidacloprid detected:

hydroxyl imidacloprid (WAK 4103, M01)

imidacloprid olefin (WAK 3745, M06)

des nitro imidacloprid (WAK 4140, M09)

6-chloronicotinic acid (6-CAN, M14).

The combined residues of imidacloprid and its four metabolites were measured as the 6-CNA trimethylsilyl ester, reported in parent equivalents. The limit of quantitation (LOQ) was established for commodities and ranged from 0.01 to 0.085 mg/kg. No quantifiable residues were observed in the control samples of commodities tested, but in three of untreated coffee samples, one of untreated pea samples, and one of untreated radish samples, low residues were detected. In the method validation and concurrent recovery tests, the majority of recoveries were within the range between 70% and 120%, with a few exceptions.

Table 1 Analytical method and its validation for commodities tested

Commodity	LOQ (mg/kg)	Residue in control sample (mg/kg)	Fortification level (mg/kg)	Recovery (%)
Blueberry: LB	0.05	< 0.05	0.05–1.0	104 ± 10
HB	0.05	< 0.05	0.05–5.00	112 ± 8
Caneberry: RB	0.027	< 0.027	0.05–5.0	97 ± 5 (*n*=19)
MB	0.065	< 0.065	0.05–5.0	96 ± 8 (*n*=5)
BOB	0.085	< 0.085	0.05–5.0	92 ± 11 (*n*=5)
BLB			0.05–5.0	93 ± 5 (*n*=3)
Strawberry	0.053	< 0.053	0.05–5.00	97 ± 11 (*n*=16)
Avocado	0.05	< 0.05	0.05–0.50	113 ± 9 (*n*=10)

Commodity	LOQ (mg/kg)	Residue in control sample (mg/kg)	Fortification level (mg/kg)	Recovery (%)
Banana	0.056	< 0.056	0.05–5.00	90 ± 9 (*n*=18)
Pea: DSP	0.037	< 0.037	0.05–3.00	77 ± 7 (*n*=31)
SSP	0.014	< 0.014	0.05–3.00	85 ± 7 (*n*=29)
EPP	0.035	< 0.035	0.05–3.00	80 ± 9 (*n*=32)
Radish: root	0.058	< 0.058	0.05–5	100 ± 15 (*n*=15)
Top	0.043	< 0.043	0.05–5	93 ± 15 (*n*=15)
Carrot: root	0.05	< 0.05	0.050–5.00	83 ± 9 (*n*=12)
Top	0.05	< 0.05[1]	0.050–5.00	87 ± 8 (*n*=12)
Tree nuts: AH	0.02	< 0.02	0.01–4.00	89–112 (*n*=16)
AN	0.01	< 0.01	0.01	74–108 (*n*=10)
PN	0.01	< 0.01	0.01	83–119 (*n*=10)
Sunflower	0.05	< 0.05	0.05–0.10	86–106 (*n*=9)
Peanut: nutmeat	0.076	< 0.076	0.05–25	96 ± 21 (*n*=31)
oil	0.032	< 0.032	0.05–25	99 ± 16 (*n*=15)
meal	0.062	< 0.062	0.05–25	91 ± 18 (*n*=12)
hay	0.068	< 0.068	0.05–25	103 ± 15 (*n*=27)
Coffee: GCB	0.01	< 0.01	0.01–1.0	100 ± 11 (*n*=26)
RCB	0.01	< 0.01	0.01–1.0	102 ± 15 (*n*=21)
FDCB	0.02	< 0.02	0.01–1.0	99 ± 12 (*n*=24)
Pomegranate	0.039	< 0.039	0.050–5.00	110 ± 8 (*n*=17)
Sugar apple	0.05	< 0.05	0.05–3.00	102 ± 28 (*n*=21)

Note: Blueberry: LB (low-bush blueberry), HB (high-bush blueberry)

Caneberry: RB (raspberry), MB (Marion berry), BOB (boysenberry), BLB (blackberry)

Coffee: GCB (green coffee bean), RCB (roast coffee bean), FDCB (freeze dried coffee bean)

Pea: DSP (dry shelled pea), SSP (succulent shelled pea), EPP (edible podded pea)

Tree nuts: AH (almond hull), AN (almond nutmeat), PN (pecan nutmeat)

Stability of residues in stored analytical samples

During supervised trials, samples were taken from fields and frozen within a few hours, and then stored under frozen conditions until analysed. The actual maximum storage interval for samples in these trials varied from 60 days to 1662 days. To evaluate storage stability, control samples were fortified with imidacloprid and its metabolites at concentrations equivalent to 0.17–1.00 mg/kg total, and analysed after 35 to 1609 days of frozen storage. The results in Table 2 indicate that the residues were stable in the commodities tested during the storage period.

Table 2 Sample storage and their stability study for the commodities tested

Commodity	Storage temperature (℃)	Actual maximum storage interval (d)	Storage stability test	Storage interval in test (d)	Fortification level (mg/kg)	Recovery (%)
Blueberry: LB	–20 to –4	60	No	–	–	–
HB	–40 to –20	434	Yes	155	0.5	67–101 (n=15)
Caneberry	< 0	83	Yes	75	0.5	87, 93, 94
Strawberry	< –17	210	No	–	–	–
Avocado	< 0	404	No	–	–	–
Banana	< 0	155	No	–	–	–
Pea: DSP	–22 to –12	995	Yes	1020	0.50	91, 96, 86

Commodity	Storage temperature (℃)	Actual maximum storage interval (d)	Storage stability test	Storage interval in test (d)	Fortification level (mg/kg)	Recovery (%)
SSP	–22 to –12	959	Yes	932	0.50	108, 112, 111
EPP	–22 to –12	958	Yes	908	0.50	95, 97, 86
Radish: root	–32 to –20	1253	Yes	1240	0.5	96, 106, 101
Top	–32 to –20	1273	Yes	1254	0.5	78, 66, 69
Carrot: root	< –20	1147	Yes	1147	1.00	84–102 (n=5)
Top	< –20	1147	Yes	1132	1.00	92–107 (n=6)
Tree nuts	–20	572	No	–	–	–
Sunflower			No	–	–	–
Peanut: nutmeat	< –17	1489	Yes	1600	1	90, 91, 93
oil	< –17	1506	Yes	1600	1	120, 124, 137
meal	< –17	1534	Yes	1595	1	77, 77, 87
hay	< –17	1662	Yes	1609	1	72, 82, 84
Coffee: GCB	–20 ± 5	591	Yes	764	0.17–0.20	93–110 (n=4)
RCB	–20 ± 5	533	Yes	779	0.17–0.20	91–98 (n=4)
FDCB	–20 ± 5	143	Yes	506	0.374	94, 87, 90
Pomegranate	< 0	99	No	–	–	–
Sugar apple	–22 to –12	94	Yes	35	1.00	113, 81, 98

Note: Blueberry: LB (low bush blueberry), HB (high bush blueberry)

Coffee: GCB (green coffee bean), RCB (roast coffee bean), FDCB (freeze dried coffee bean)

Pea: DSP (dry shelled pea), SSP (succulent shelled pea), EPP (edible podded pea)

USE PATTERN

Imidacloprid is registered for use in the USA and the information of newly accepted labels relevant to this evaluation is summarized in Table 3. Japan also provided the use patterns of imidacloprid application on agricultural and horticultural crops in Japan.

Table 3 The registered GAP for imidacloprid application on crops in the USA

Crop	Formulation	Method	Rate (kg ai/ha)		Maximum application / season	Minimum interval between application (d)	Minimum water volume (L/ha)	PHI (d)
			Each application	Maximum / season				
Blueberry	Admire 2 FL	Soil application	0.28–0.56	0.56	1	–	–	7
Blueberry	Provado 1.6 F	Foliar spray	0.042–0.112	0.56	5	7	187 (G)[a] 47 (A)	3
Caneberry	Admire 2 FL	Soil application	0.28–0.56	0.56	1	–	–	7
Caneberry	Provado 1.6 F	Foliar spray	0.112	0.336	3	7	–	3
Strawberry	Admire 2 FL	Soil application	0.42–0.56 0.28–0.42[b]	0.56 0.42[b]	1 1[b]	– –	– –	14 14[b]
Strawberry	Provado 1.6 F	Foliar spray	0.0532	0.16	3	5	–	7
Avocado	Admire 2 FL	Soil application	0.42–0.56	0.56	1	–	–	6

Crop	Formulation	Method	Rate (kg ai/ha)		Maximum application / season	Minimum interval between application (d)	Minimum water volume (L/ha)	PHI (d)
			Each application	Maximum / season				
Avocado	Provado 1.6 F	Foliar spray	0.112	0.56	5	10	–	7
Banana	Admire 2 FL	Soil application	0.28–0.56	0.56	1	–	–	0
Banana	Provado 1.6 F	Foliar spray	0.112	0.56	5	14	–	0
Pea	Gaucho 480 FS	Seed application	0.558–1.116[c]	1.116[c]	1	–	–	
Pea	Admire 2 FL	Soil application	0.28–0.42	0.42	1	–	–	21
Pea	Provado 1.6 F	Foliar spray	0.049	0.147	3	7	–	7
Radish	Admire 2 FL	Soil application	0.175–0.42	0.42	1	–	–	21
Radish	Provado 1.6 F	Foliar spray	0.049	0.049	1	–	–	7
Carrot	Admire 2 FL	Soil application	0.175–0.42	0.42	1	–	–	21
Carrot	Provado 1.6 F	Foliar spray	0.049	0.147	3	5	–	7
Tree nuts	Admire 2 FL	Soil application	0.28–0.56	0.56	1	–	–	7
Tree nuts	Provado 1.6 F	Foliar spray	0.049–0.112	0.403	4	6	468 (G) 234 (A)	7
Sunflower	Gaucho 480 FS	Seed treatment	4.85–9.7[c]	9.7[c]	1	–	–	-
Peanut	Admire 2 FL	Soil application	0.28–0.42	0.42	1	–	–	14
Peanut	Provado 1.6 F	Foliar spray	0.049	0.147	3	5	–	14
Coffee	Admire 2 FL	Soil application	0.28–0.56	0.56	1	–	–	7
Coffee	Provado 1.6 F	Foliar spray	0.112	0.56	5	7	–	7
Pomegranate	Admire 2 FL	Soil application	0.28–0.56	0.56	1	–	–	0
Pomegranate	Provado 1.6 F	Foliar spray	0.112	0.336	3	7	–	7
Sugar apple	Admire 2 FL	Soil application	0.42–0.56	0.56	1	–	–	6
Sugar apple	Provado 1.6 F	Foliar spray	0.112	0.56	5	10	–	7

[a] Foliar spray: G (ground application) or A (aerial application)

[b] post-harvest use on perennial strawberry

[c] g ai/kg seeds

RESIDUES RESULTING FROM SUPERVISED TRIALS

Supervised field trials were conducted on blueberries, caneberries (blackberries, raspberries, boysenberries and Marionberries), strawberries, avocadoes, bananas, peas, radishes, carrots, tree nuts (almonds and pecans), sunflowers, peanuts, coffee, pomegranates and sugar apples in the USA and Canada. A summary of the data received is summarized in Table 4.

Table 4 Supervised trials conducted with imidacloprid

Commodity	Group	Table No
Blueberry	Berries and other small fruits	Table 5
Lowbush blueberry		
Highbush blueberry		
Blackberry		Table 6
Marion Blackberry		
Raspberry		
Boysenberry		
Strawberry		Table 7
Avocado	Tropical fruits, inedible peel	Table 8
Banana		Table 9
Pomegranate		Table 10
Sugar apple		Table 11
Dry, shelled pea	Pulses	Table 12
Succulent, shelled pea	Legume vegetables	
Edible podded pea		
Radish	Root and tuber vegetables	Table 13
Carrot		Table 14
Almond	Tree nuts	Table 15
Pecan		Table 16
Sunflower	Oilseeds	Table 17
Peanut		Table 18
Coffee		Table 19

Three formulations of imidacloprid, Provado 1.6 F (1.6 lb ai/gal, 17.4%), Admire 2 FL (2 lb ai/gal, 21.4%), and Gaucho 480 FS (4 lb ai/gal or 480 g ai/L, 40.7%) were used in these field trials. Provado was applied for foliar spray, Admire was as the soil application and Gaucho for the seed treatment. Each of the field trial sites generally consisted of one untreated control plot and one treated plot. Single samples were collected from each of the untreated control plots or treated plots, while for most trial plots, duplicate samples were collected from the same plot.

Besides the information on field plots, imidacloprid application and sampling, the data of the supervised field trials also included the details on method validation, storage stability tests and sample analyses. When residues were not detected they are shown as below the LOQ. Although trials included control plots, no control data are recorded in the tables except where residues in control samples exceeded the LOQ. Residue data are recorded unadjusted for recovery. Values double underlined are within maximum GAP (± 30%) and were considered for the estimation of maximum residue levels, STMRs and HRs.

Blueberries

Eleven field trials were conducted on blueberries in the USA in 1997–1998 (Dorschner, KW 2001a, b), including two trials in Maine on low-bush blueberries, and nine trials in New Jersey, North Carolina, Michigan, Pennsylvania and Oregon on high-bush blueberries. Each of the field trial sites consisted of one untreated control plot and one treated plot; the three Michigan trials used two treated plots each, one for a soil application and the other for foliar applications.

In the two field trials on low-bush blueberries in Maine in 1997, the treated plots received two foliar broadcast applications of the Provado 1.6 F at a total rate of 0.21–0.22 kg ai/ha and a 21 day

retreatment interval, with an organo-silicone surfactant Kinetic-I mixed in the solutions. Duplicate samples were collected 21 or 22 days following the final (second) application.

In the five trials on high-bush blueberries in 1997, Admire 2 FL was applied one time as a soil-directed spray at 0.55–0.65 kg ai/ha (with one trial exception of 0.88 kg ai/ha), and immediately following the application the plots were irrigated with water to wash the test substances into the soil. In the 1997 Michigan (separate plots from the soil treatment) and the four 1998 trials on high-bush blueberries, five foliar applications of Provado 1.6 F were made 6 to 9 days apart to plots at a total rate of 0.56 kg ai/ha. Kinetic or Silwet-1 was included in the tank mixes in the four 1998 trials. Single or duplicate samples of mature high-bush blueberries were collected 7 and 14-15 days following the soil application and 2–4 days following the final foliar applications. To examine the decline of residues, samples were also collected 28 and 32–35 days after soil applications at two trials and 0, 10 and 14 days following the final foliar applications at the 1998 Oregon trial.

The LOQ was estimated at 0.05 mg/kg for both low-bush and high-bush blueberries. The analysis method was validated using fortified samples at 0.05–5.00 mg/kg of equimolar concentrations of imidacloprid and its metabolites, with the recoveries of 87% ± 5% at LOQ and 104% ± 10% at all fortifications for low-bush blueberries, or 117% ± 8% at LOQ and 112% ± 8% at all fortifications for high-bush blueberries, respectively. In a sample storage test on high-bush blueberries, control samples were fortified to 0.50 mg/kg and stored at –40 ℃ to –20 ℃ for 155 days Recoveries of 67–101% were obtained.

The registered GAP for imidacloprid application on blueberries in the USA is one soil application of Admire 2 FL at 0.28–0.56 kg ai/ha with a PHI of 7 day, or one to five foliar applications of Provado 1.6 F at a maximum rate per crop season of 0.56 kg ai/ha with a minimum interval between applications of 7 days and a PHI of 3 days. For the foliar use of Provado 1.6 F, the minimum application volume of water is 190 L/ha for ground application or 47 L/ha for aerial application.

Table 5 Summary of imidacloprid residues following soil or foliar applications to blueberry trees in the USA

BLUEBERRY Country Year (variety)	Formulation	Total application rate (kg ai/ha)	Spray volume (L/ha)	No	Interval (d)	Commodity	PHI (d)	Residue (mg/kg)	Study No
Low-bush blueberry									
Maine, US, 1997, (wild)	1.6 FL[a]	0.21	234	2	21	Fruit	22	1.0, 1.0	IR-4 06700 97-ME01
Maine, US, 1997, (wild)	1.6 FL[a]	0.22	234	2	21	Fruit	21	0.83, 0.54	IR-4 06700 97-ME02
High-bush blueberry									
New Jersey, US, 1997, (Bluecrop)	2 FL	0.56	166	1	–	Fruit	7 14 28 32	< 0.05 < 0.05 < 0.05 < 0.05	IR-4 06817 97-NJ26
North Carolina, US, 1997, (Croatan)	2 FL	0.56	86	1	–	Fruit	7 15	< 0.05 < 0.05	IR-4 06817 97-NC08
Michigan, US, 1997, (Jersey)	2 FL	0.88	75	1	–	Fruit	7 14	< 0.05 < 0.05	IR-4 06817 97-MI11

BLUEBERRY Country Year (variety)	Formulation	Total application rate (kg ai/ha)	Spray volume (L/ha)	No	Interval (d)	Commodity	PHI (d)	Residue (mg/kg)	Study No
							28 35	< 0.05 < 0.05	
Michigan, US, 1997, (Jersey)	2 FL	0.65	103	1	–	Fruit	7 14	< 0.05 < 0.05	IR-4 06817 97-MI12
Michigan, US, 1997, (Jersey)	2 FL	0.61	98	1	–	Fruit	7 14	< 0.05, 0.09 < 0.05, 0.09	IR-4 06817 97-MI13
Michigan, US, 1997, (Jersey)	1.6 FL	0.56	455–495	5	6–9	Fruit	3	0.46, 0.49	IR-4 06817 97-MI11
Michigan, US, 1997, (Jersey)	1.6 FL	0.56	441–526	5	7	Fruit	3	0.33, 0.52	IR-4 06817 97-MI12
Michigan, US, 1997, (Jersey)	1.6 FL	0.56	448–498	5	6–8	Fruit	3	0.33, 0.38	IR-4 06817 97-MI13
North Carolina, US, 1998, (Croatan)	1.6 FL[a]	0.56	311–340	5	6–8	Fruit	2	1.6, 2.2	IR-4 06817 98-NC19
Pennsylvania, US, 1998, (Bluecrop)	1.6 FL[a]	0.56	483–557	5	6–8	Fruit	2	2.3, 2.8	IR-4 06817 98-PA02
New Jersey, US, 1998, (Bluecrop)	1.6 FL[a]	0.56	201–205	5	6–8	Fruit	4	0.83, 0.89	IR-4 06817 98-NJ15
Oregon, US, 1998, (Bluecrop)	1.6 FL[a]	0.56	377–400	5	7	Fruit	0 3 10 14	1.5, 1.5 1.1, 1.1 1.0, 1.1 1.1, 1.0	IR-4 06817 98-OR20

[a] an organo-silicone surfactant, Kinetic-I or Silwet-1, was added to the solutions

Blackberries, Raspberries and Boysenberries

Nine field trials were conducted during the 2003 growing season on caneberries in the USA and Canada (Dorschner, KW 2006a). Among them, three trials were conducted on blackberries, one each in New Jersey, North Carolina and Oregon; four trials on raspberries, one each in Michigan, Washington, California and Quebec, Canada; one trial on Marionberries (Oregon); and one trial on boysenberries (California).

At each trial, three foliar applications of Provado 1.6 F at a total rate of 0.34–0.35 kg ai/ha were made without adjuvant. In all but the Michigan raspberry trial, the applications were made 6 to 8 days apart. In the Michigan trial, poor weather conditions postponed the third application until 11 days after the second. Each field trial consisted of one untreated control plot and one treated plot. Duplicate samples of mature caneberries were collected from each plot 2 to 4 days after the final applications.

The LOQ was calculated as 0.027 mg/kg for raspberries, 0.085 mg/kg for boysenberries, and 0.065 mg/kg for Marion Blackberries. Method validation recoveries by fortifications at 0.05–5.0 mg/kg were 92–105% for raspberries, 87–97% for blackberries, 79–106% for boysenberries, and

83–103% for Marion Blackberries. The maximum storage interval for field-treated samples was 83 days. Based on a storage stability test performed on raspberry samples stored frozen for 75 days, the recoveries were 87–94% at 0.5 mg/kg fortified.

The registered label for imidacloprid application on caneberries in the USA is one soil application of Admire 2 FL at 0.28–0.56 kg ai/ha with a PHI of 7 days, or one to three foliar applications of Provado 1.6 F at a maximum rate per crop season of 0.34 kg ai/ha with a minimum interval between applications of 7 days and a PHI of 3 days.

Table 6 Summary of imidacloprid residues following foliar application to caneberry trees in the USA and Canada

CANEBERRY Country Year (variety)	Formulation	Total application rate (kg ai/ha)	No	Interval (d)	Commodity	PHI (d)	Residue (mg/kg)	Study No
Blackberry								
New Jersey, US, 2003, (Chester)	1.6 FL	0.35	3	6–7	Fruit	2	0.38, 0.32	IR-4 08257 03-NJ35
North Carolina, US, 2003, (Shawnee)	1.6 FL	0.34	3	6–8	Fruit	4	0.69, 0.58	IR-4 08257 03-NC29
Oregon, US, 2003, (Thornless Evergreen)	1.6 FL	0.34	3	6–8	Fruit	2	0.70, 0.54	IR-4 08257 03-OR18
Marion Blackberry								
Oregon, US, 2003, (Marion)	1.6 FL	0.35	3	7	Fruit	3	1.7, 1.5	IR-4 08257 03-OR19
Raspberry								
Michigan, US, 2003, (Heritage)	1.6 FL	0.35	3	7–11	Fruit	3	0.59, 0.59	IR-4 08257 03-MI43
Washington, US, 2003, (Meeker)	1.6 FL	0.35	3	7	Fruit	2	0.96, 0.95	IR-4 08257 03-WA22
California, US, 2003, (Isabel)	1.6 FL	0.35	3	6–8	Fruit	3	0.48, 0.44	IR-4 08257 03-CA134
Quebec, Canada, 2003, (Kilasure)	1.6 FL	0.35	3	7–8	Fruit	3	0.49, 0.41	IR-4 08257 03-QC14
Boysenberry								
California, US, 2003, (Boysenberry)	1.6 FL	0.34	3	6–8	Fruit	3	1.5, 1.4	IR-4 B7333 03-CA135

Strawberries

Nine field trials were conducted on strawberries in the USA in 1998–1999 (Dorschner, KW 2002e), three each in Florida and California; and one each in New Jersey, Wisconsin and Oregon. Each of the field trial sites consisted of one untreated control plot and one treated plot. At each trial one drench application of Admire 2 FL at 0.420 kg ai/ha was followed by three foliar applications of Provado 1.6 F at a total rate of 0.049 kg ai/ha. The total amount of imidacloprid applied was 0.57 kg ai/ha. The drench application was made 31 to 32 days before harvest at five trials; 41 days at the New Jersey trial; and 42 to 85 days at the Florida trials (once plant roots were established). The foliar applications were made 4 to 6 days apart, 13 to 62 days after the drench application. Kinetic spray adjuvant was included in the foliar spray tank mixes at the 1998 trials; Silwet was added to the tank mixes in the 1999 trials. Single or duplicate samples of strawberries were collected 6 to 7 days after the final application, and additional treated samples were collected at 0, 4 and 14 days from one trial.

The LOQ was set as 0.053 mg/kg. Control samples were fortified with equimolar mixtures of imidacloprid and metabolites to 0.05–5.00 mg/kg, the recoveries of 94% ± 9% at 0.05 mg/kg and 97% ± 11% at all fortifications were obtained. The maximum storage interval for field-treated samples was 210 days. No storage stability study was performed.

The registered GAP for imidacloprid application on strawberries in the USA is one soil application of Admire 2 FL at 0.42–0.56 kg ai/ha with a PHI of 14 days (or at 0.28–0.42 mg ai/ha for post-harvest use on perennial strawberries), or one to three foliar applications of Provado 1.6 F at a maximum rate per crop season of 0.16 kg ai/ha, with a minimum interval between applications of 5 days and a PHI of 7 days.

Table 7 Summary of imidacloprid residues following foliar and soil application to strawberries in the USA

STRAWBERRY Country Year (variety)	Formulation	Total application rate (kg ai/ha)	No	Interval (d)	PHI (d)	Commodity	Residue (mg/kg)	Study No
Florida, US, 1998, (93–100 Experimental Line)	2 FL 1.6 FL[a]	0.420 0.148	1 3	– 4–6	7	Fruit	0.26, 0.35	IR-4 06260 98-FL30
California, US, 1998, (Camarosa)	2 FL 1.6 FL[a]	0.420 0.148	1 3	– 4–6	6	Fruit	0.12, 0.14	IR-4 06260 98-CA121
California, US, 1998,(Selva)	2 FL 1.6 FL[a]	0.420 0.148	1 3	– 5	7	Fruit	0.18, 0.21	IR-4 06260 98-CA119
California, US, 1998, (Selva)	2 FL 1.6 FL[a]	0.420 0.148	1 3	– 5	7	Fruit	0.14, 0.15	IR-4 06260 98-CA120
Florida, US, 1998, (Carlsbad)	2 FL 1.6 FL[a]	0.420 0.148	1 3	– 4–6	7	Fruit	0.32	IR-4 06260 98-FL70
Florida, US, 1998, (Camarosa)	2 FL 1.6 FL[a]	0.420 0.148	1 3	– 4–5	0 4 7 14	Fruit Fruit Fruit Fruit	0.19, 0.22 0.16, 0.16 0.14, 0.15 0.12, 0.13	IR-4 06260 98-FL71
New Jersey, US, 1999, (Midway)	2 FL 1.6 FL[a]	0.420 0.148	1 3	– 5–6	6	Fruit	0.16, 0.17	IR-4 06260 99-NJ30
Wisconsin, US, 1999, (Honeoye)	2 FL 1.6 FL[a]	0.420 0.148	1 3	– 6	7	Fruit	0.11, 0.12	IR-4 06260 99-WI20
Oregon, US, 1999, (Totem)	2 FL 1.6 FL[a]	0.420 0.148	1 3	– 5–6	7	Fruit	0.13, 0.17	IR-4 06260 99-OR25

[a] an organo-silicone surfactant, Kinetic or Silwet, added in the solutions

Avocadoes

Five field trials were conducted on avocadoes in Florida and Puerto Rico in 2000 (Samoil, KS 2004). In all trials, Admire 2 FL was used for one soil application at 0.54–0.58 kg ai/ha. In two trials in southern Florida, Admire in water was applied to the soil at the base of the treated trees from a watering can. In the other three trials in Puerto Rico, a CO_2 boom sprayer mounted on a bicycle was used to apply Admire to the soil at the base of the trees. Treated and untreated avocadoes were collected 50–69 days after the applications in each trial. In trial FL06, additional treated samples were collected 88 and 116 days after the application. After harvest, the samples of avocado fruits were cut to remove seeds before being frozen and stored.

The limit of quantitation (LOQ) for the method was established at 0.05 mg/kg. In the samples fortified with equimolar mixtures of imidacloprid and its metabolites at 0.05 mg/kg and 0.50 mg/kg, the recoveries were 111–121% and 97–120%, respectively. No storage stability study was performed.

The registered GAP for imidacloprid application on avocadoes in the USA is one soil application of Admire 2 FL at 0.42–0.56 kg ai/ha with a PHI of 6 days, or one to five foliar applications of Provado 1.6 F at a maximum rate per crop season of 0.56 kg ai/ha with a minimum interval between applications of 10 days and a PHI of 7 days.

Table 8 Summary of imidacloprid residues following soil application to avocado trees in the USA

AVOCADO Country Year (variety)	Formulation	Total application rate (kg ai/ha)	No	Commodity	PHI (d)	Residue (mg/kg)	Study No
Florida, US, 2000, (Peterson)	2 FL	0.56	1	Unpeeled fruit without seed	60 88 116	< 0.050, < 0.050 < 0.050, < 0.050 < 0.050, < 0.050	IR-4 07099 00-FL06
Florida, US, 2000, (Booth 8)	2 FL	0.56	1	Unpeeled fruit without seed	60	< 0.050, < 0.050	IR-4 07099 00-FL61
Puerto Rico, US, 2000, (Simmons)	2 FL	0.54	1	Unpeeled fruit without seed	59	< 0.050, < 0.050	IR-4 07099 00-PR02
Puerto Rico, US, 2000, (Butler)	2 FL	0.56	1	Unpeeled fruit without seed	69	< 0.050, < 0.050	IR-4 07099 00-PR03
Puerto Rico, US, 2000, (Semil 34)	2 FL	0.58	1	Unpeeled fruit without seed	50	< 0.050, < 0.050	IR-4 07099 00-PR05

Bananas

Five field trials were performed on bananas in Hawaii during the 2001 growing season (Dorschner, KW 2005a). Each field trial site consisted of one untreated control plot and one treated plot. At each trial, five foliar applications of Provado 1.6 F at a rate of 0.55–0.58 kg ai/ha were applied 14 days apart to bananas trees. An organo-silicone surfactant, Kinetic-I, was added in the ratio of 0.0156% into the spray solutions. At the 01-HI05 trial, the fifth foliar application was followed by one soil-surface application of Admire 2 FL at 0.59 kg ai/ha on the same day, and a total of 1.15 kg ai/ha was applied at this trial. At the 01-HI04 trial, bunches were bagged following the first application after the spray mixture dried. Duplicate samples were collected from each plot following the final application, after the spray mixture dried. Samples for decline determination were collected at 3, 7, 14 and 28 days from the 01-HI05 trial.

The LOQ for the method was calculated at 0.056 mg/kg. In samples fortified with equimolar mixtures of imidacloprid and its metabolites at 0.050 to 5.0 mg/kg, the recoveries ranged from 81 to 99%. No storage stability study was performed.

The registered label for imidacloprid application on bananas in the USA is one soil application of Admire 2 FL at 0.28–0.56 kg ai/ha with a PHI of 0 day, or one to five foliar applications of Provado 1.6 F at a maximum rate per crop season of 0.56 kg ai/ha with a minimum interval between applications of 14 days and a PHI of 0 day.

Table 9 Summary of imidacloprid residues following foliar application to banana trees in the USA

BANANA Country Year (variety)	Formulation	Total application rate (kg ai/ha)	No	Interval (d)	Commodity	PHI (d)	Residue (mg/kg)	Study No
Hawaii, US, 2001,	1.6 FL[a]	0.56	5	14	Fruit unpeeled	0	0.36, <u>0.44</u>	IR-4 B7333 01-HI01

BANANA Country Year (variety)	Formulation	Total application rate (kg ai/ha)	No	Interval (d)	Commodity	PHI (d)	Residue (mg/kg)	Study No
(Williams)								
Hawaii, US, 2001, (Williams)	1.6 FL[a]	0.58	5	14	Fruit unpeeled	0	0.45, 0.50	IR-4 B7333 01-HI02
Hawaii, US, 2001, (Apple)	1.6 FL[a]	0.57	5	14	Fruit unpeeled	0	0.50, 0.53	IR-4 B7333 01-HI03
Hawaii, US, 2001, (Williams)	1.6 FL[a]	0.55	5	14	Fruit unpeeled	0	0.10, 0.13	IR-4 B7333 01-HI04
Hawaii, US, 2001, (Williams)	1.6 FL[a] + 2 FL[b]	0.56 + 0.59[b]	5 + 1[b]	14 or 0[b]	Fruit unpeeled	0 3 7 14 28	0.42, 0.44 0.47, 0.53 0.56, 0.63 0.47, 0.51 0.37, 0.42	IR-4 B7333 01-HI05

[a] an organo-silicone surfactant, Kinetic-I, added in the solutions

[b] an additional soil application of Admire 2 FL at 0.59 kg ai/ha after the fifth foliar application of Provado 1.6 F on the same day

Pomegranates

Three field trials were conducted on pomegranates in California, (the major pomegranate-growing region of the USA), during the 2002 growing season (Dorschner, KW 2004a). Each field trial consisted of one untreated control plot and one treated plot. One soil-surface application of Admire 2 FL at 0.32–0.35 kg ai/ha was followed by three foliar applications of Provado 1.6 F at a total rate of 0.34 kg ai/ha. A total imidacloprid amount of 0.66–0.69 kg ai/ha was applied to each treated plot. No adjuvant was added to the spray mixtures. The soil-surface application was made 50 days prior to harvest; the foliar applications were made 7 days apart and timed so that pomegranates could be collected 7 days following the final application.

The LOQ was established as 0.039 mg/kg. For control samples fortified with equimolar mixtures of imidacloprid and metabolites at 0.050–5.0 mg/kg the method validation recoveries ranged from 100 to 128%. The maximum storage interval for field-treated samples was 99 days. No storage stability study was performed.

The registered GAP for imidacloprid application on pomegranate in the USA is one soil application of Admire 2 FL at 0.28–0.56 kg ai/ha with a PHI of 0 day, or one to three foliar applications of Provado 1.6 F at a maximum rate per crop season of 0.336 kg ai/ha with a minimum interval between applications of 7 days and a PHI of 7 days.

Table 10 Summary of imidacloprid residues following foliar and soil application to pomegranates in the USA

POMEGRANATE Country Year (variety)	Formulation	Total application rate (kg ai/ha)	No	Interval (d)	PHI (d)	Commodity	Residue (mg/kg)	Author Date Study No
California, US, 2002 (Wonderful)	2 FL 1.6 FL	0.32 0.34	1 3	– 7	7	Whole fruit	0.42, 0.43	IR-4 08254 02-CA120
California, US, 2002	2 FL 1.6 FL	0.34 0.34	1 3	– 7	7	Whole fruit	0.41, 0.42	IR-4 08254 02-CA121

POMEGRANATE Country Year (variety)	Formulation	Total application rate (kg ai/ha)	No	Interval (d)	PHI (d)	Commodity	Residue (mg/kg)	Author Date Study No
(Wonderful)								
California, US, 2002 (Wonderful)	2 FL 1.6 FL	0.35 0.34	1 3	– 7	7	Whole fruit	0.55, 0.46	IR-4 08254 02-CA122

Sugar apples

Three field trials were conducted on sugar apples in Homestead, Florida in 2001 (Samoil, KS 2003a). Sugar apple trees were sprayed with Provado 1.6 F at 0.57–0.59 kg ai/ha using either an air blast sprayer or a CO_2 boom sprayer. Five applications were made at intervals of 7 to 11 days. Duplicate samples were collected 14–15 days after the last applications to the treated plots.

The LOQ was established as 0.05 mg/kg. For control samples fortified with equimolar mixtures of imidacloprid and metabolites at 0.05–3.0 mg/kg, the average method validation recoveries were 104% ± 38% at LOQ and 102% ± 28% at all fortifications. The maximum storage interval for field-treated samples was 94 days. In a storage stability test, control samples were fortified with 1.0 mg/kg imidacloprid and stored under –22 to –12°C for 35 days, the recoveries obtained were 81–113%.

The registered label for imidacloprid application on sugar apples in the USA is one to five foliar applications of Provado 1.6 F at a total rate of 0.56 kg ai/ha with a minimum interval between applications of 10 days and a PHI of 7 days.

Table 11 Summary of imidacloprid residues following foliar application to sugar apples in the USA

SUGAR APPLE Country Year (variety)	Formulation	Total application rate (kg ai/ha)	No	Interval (d)	PHI (d)	Commodity	Residue (mg/kg)	Study No
Florida, US, 2001 (Red)	1.6 FL[a]	0.568	5	7–11	14	Fruit	0.07, 0.17	IR-4 06993 01-FL10
Florida, US, 2001 (Red)	1.6 FL[1]	0.582	5	7	15	Fruit	0.075, 0.15	IR-4 06993 01-FL11
Florida, US, 2001 (Green)	1.6 FL[a]	0.594	5	7–11	15	Fruit	< 0.05, 0.10	IR-4 06993 01-FL12

[a] an organosilicone surfactant, Kinetic added in the solutions

Peas

A total of sixteen field trials were conducted on peas in Wisconsin, Ohio, Washington, Maryland, New Jersey and California, in 1997–1999 (Dorschner, KW 2002a). Among them, six trials were performed on dry shelled peas, six on succulent shelled peas and four on edible podded peas. Each field trial site consisted of one untreated control plot and one treated plot. Three formulations of imidacloprid were used for the application. Pea seeds were first treated with Gaucho 480 FS at 2.2 g ai/kg seeds and then sent to the trial sites for planting. At the trial sites, the treated plots received one in-furrow application of Admire 2 FL (with one trial exception using two soil applications) and three foliar applications of Provado 1.6 F. The in-furrow application was made at 0.42 kg ai/ha at planting (with another trial exception at 0.18 kg ai/ha); then after 40–87 days the foliar applications

were made 6 to 8 days apart at a total rate of 0.15 kg ai/ha with Kinetic or Silwet spray adjuvant included in tank mixtures. At fifteen of the trials, the total amount of imidacloprid applied was 0.57 kg ai/ha. The exception was at the 1997 California edible-podded pea trial, in which 0.32 kg ai/ha imidacloprid was applied.

At each trial, duplicate samples of shelled (dry or succulent) or edible-podded peas were collected 6 to 8 days after the final application. Additional treated samples were collected at 3 and 13–14 days from two succulent trials, and one edible-podded trial. At the three Washington dry pea trials, the plants were cut and left in the field to dry for several days before sample collections. For the dry and succulent samples, the peas were shelled and the pods discarded.

The LOQ was calculated at 0.037 mg/kg for dry shelled peas, 0.014 mg/kg for succulent shelled peas, and 0.035 mg/kg for edible-podded peas. In the control samples fortified with equimolar mixtures of imidacloprid and its metabolites at 0.05 to 3.0 mg/kg the recoveries were 77% ± 7% for dry shelled peas, 85% ± 7% for succulent shelled peas, and 80% ± 9% for edible-podded peas at all fortifications. The maximum storage interval for field-treated samples was 995 days for dry shelled peas, 959 days for succulent shelled peas, and 958 days for edible-podded peas. In a storage stability test, control samples of each pea type were fortified with imidacloprid at 0.50 mg/kg and stored under –22 to –12 °C for 960 days (dry), 932 days (succulent), or 908 days (edible-podded). Recoveries obtained were 86–96% for dry shelled peas, 108–112% for succulent shelled peas, and 86–97% for edible podded peas.

The registered GAP for imidacloprid application on peas in the USA is one seed treatment at a maximum rate of 1.116 g ai/kg seeds, or one soil application of Admire 2 FL at 0.28–0.42 kg ai/ha with a PHI of 21 days, or one to three foliar applications of Provado 1.6 F at a maximum rate per crop season of 0.15 kg ai/ha with a minimum interval between applications of 7 days and a PHI of 7 days.

Table 12 Summary of imidacloprid residues following seed treatment, soil and foliar application to peas in the USA

PEA Country Year (variety)	Formulation	Total application rate (g ai/kg seeds or kg ai/ha)	No	Interval (d)	PHI (d)	Commodity	Residue (mg/kg)	Study No
Dry, Shelled Pea								
Wisconsin, US, 1997, (Profi Yellow)	480 FS 2 FL 1.6 FL[a]	2.23 0.420 0.148	1 1 3	– – 7	8	DSP [b]	0.11, 0.14	IR-4 06398 97-WI15
Ohio, US, 1997, (Profi Yellow)	480 FS 2 FL 1.6 FL[a]	2.23 0.420 0.148	1 1 3	– – 6–8	8	DSP	0.22, 0.32	IR-4 06398 97-OH[c]21
Washington, US, 1997, (Columbian)	480 FS 2 FL 1.6 FL[a]	2.23 0.420 0.148	1 1 3	– – 7	3 7 13	DSP DSP DSP	0.59, 0.79 0.59, 1.0 0.62, 1.0	IR-4 06398 97-WA[c]36
Washington, US, 1997, (Columbian)	480 FS 2 FL 1.6 FL[a]	2.23 0.420 0.148	1 1 3	– – 7	7	DSP	0.47, 0.91	IR-4 06398 97-WA[c]37
Washington, US, 1997, (Columbian)	480 FS 2 FL 1.6 FL[a]	2.23 0.420 0.148	1 1 3	– – 7	7	DSP	0.71, 0.94	IR-4 06398 97-WA[c]38
Ohio, US, 1998, (Maestro)	480 FS 2 FL 1.6 FL[a]	2.23 0.420 0.148	1 1 3	– – 7	7	DSP	0.17, 0.20	IR-4 06398 98-OH[c]13

PEA Country Year (variety)	Formulation	Total application rate (g ai/kg seeds or kg ai/ha)	No	Interval (d)	PHI (d)	Commodity	Residue (mg/kg)	Study No
Succulent, Shelled Pea								
Maryland, US, 1997, (Rigo)	480 FS 2 FL 1.6 FL[a]	2.23 0.420 0.148	1 1 3	– – 7	7	SSP	0.49, 0.54	IR-4 06398 97-MD05
New Jersey, US, 1997, (Bolero)	480 FS 2 FL 1.6 FL[a]	2.23 0.417 0.148	1 2 3	– – 6-8	6	SSP	0.36, 0.42	IR-4 06398 97-NJ25
Wisconsin, US, 1997, (DMC 50-63)	480 FS 2 FL 1.6 FL[a]	2.23 0.420 0.148	1 1 3	– – 7–8	7	SSP	0.20, 0.31	IR-4 06398 97-WI13
Wisconsin, US, 1997, (DMC 50-63)	480 FS 2 FL 1.6 FL[a]	2.23 0.420 0.148	1 1 3	– – 6–7	7	SSP	0.77, 0.88	IR-4 06398 97-WI14
Ohio, US, 1997, (Maestro)	480 FS 2 FL 1.6 FL[a]	2.23 0.420 0.148	1 1 3	– – 6–7	8	SSP (CK)	0.37, 0.62 (0.16, 0.22)	IR-4 06398 97-OH*19
Washington, US, 1997, (Early Perfection)	480 FS 2 FL 1.6 FL[a]	2.23 0.420 0.148	1 1 3	– – 7	3 7 14	SSP SSP SSP	0.71, 0.76 0.93, 1.1 0.64, 0.81	IR-4 06398 97-WA*39
Edible Podded Pea								
California, US, 1997, (Oregon Sugar Pod II)	480 FS 2 FL 1.6 FL[a]	2.23 0.177 0.148	1 1 3	– – 6–7	7	EPP	0.18, 0.20	IR-4 06398 97-CA*59
Ohio, US, 1997, (Sugar Ann)	480 FS 2 FL 1.6 FL[a]	2.23 0.420 0.148	1 1 3	– – 6–8	6	EPP	2.4, 3.8	IR-4 06398 97-OH*20
Washington, US, 1997, (Oregon Giant)	480 FS 2 FL 1.6 FL[a]	2.23 0.420 0.148	1 1 3	– – 7	3 7 14	EPP EPP EPP	0.72, 0.79 0.84, 0.92 0.80, 0.89	IR-4 06398 97-WA*40
California, US, 1999, (Mammoth Melting Sugar)	480 FS 2 FL 1.6 FL[a]	2.23 0.420 0.148	1 1 3	– – 6–8	7	EPP	0.18, 0.27	IR-4 06398 99-CA*132

[a] an organo-silicone surfactant, Kinetic-I, added in the solutions

[b] Pea: DSP (dry shelled pea), SSP (succulent shelled pea), EPP (edible podded pea)

Radishes

Five field trials were conducted on radishes in California, New Jersey, Indiana, and Florida (two trials), USA in 1997 (Dorschner, KW 2002c). Each of the five field trial sites consisted of one untreated control plot and at least one treated plot. Two treated plots were established at the Indiana trial, one for collection of tops and the other for collection of roots. At the four remaining trials, one treated plot was used. Each treated plot received one in-furrow application of Admire 2 FL at 0.42 kg ai/ha (with one exception of 0.69 kg ai/ha) at planting and one foliar application of Provado 1.6 F at 0.049 kg ai/ha with Kinetic spray adjuvant at 25 to 35 days after planting. The total amount of imidacloprid applied at each trial was 0.47 kg ai/ha (with the one exception of 0.73 kg ai/ha). Mature

radish tops and roots were collected 6 to 8 days following the final application. At the 97-FL24 trial, additional samples were collected at 3 and 12 days for decline determination.

The LOQ was established as 0.058 mg/kg in roots and 0.043 mg/kg in tops. For control samples fortified with equimolar mixtures of imidacloprid and metabolites at 0.05–5 mg/kg, the average method validation recoveries were 81% ± 10% at LOQ and 93% ± 4% at all fortifications for roots, 100% ± 15% at LOQ and 93% ± 15% at all fortifications for tops. The maximum storage interval for field-treated samples was 1253 days (roots) or 1273 days (tops). In a storage stability test, control samples were fortified with 0.5 mg/kg imidacloprid and stored under –32 to –20 °C for 1240 days (roots) or 1254 days (tops). The recoveries obtained were 96–106% in roots and 66–78% in tops.

The registered label for imidacloprid application on radishes in the USA is one soil application of Admire 2 FL at 0.18–0.42 kg ai/ha with a PHI of 21 days, or one foliar application of Provado 1.6 F at 0.049 kg ai/ha with a PHI of 7 days.

Table 13 Summary of imidacloprid residues following foliar and soil application to radish in the USA

RADISH Country Year (variety)	Formulation	Total application rate (kg ai/ha)	No	Interval (d)	PHI (d)	Commodity	Residue (mg/kg)	Study No
California, US, 1997, (Cherry Belle)	2 FL 1.6 FL[a]	0.685 0.049	1 1	– –	8	Roots Tops	< 0.05 1.8, 1.8 (CK0.055)	IR-4 06308 97-CA58
New Jersey, US, 1997, (Cherry Belle)	2 FL 1.6 FL[a]	0.420 0.049	1 1	– –	7	Roots Tops	0.12, 0.13 2.7, 2.7	IR-4 06308 97-NJ24
Indiana, US, 1997, (Champion)	2 FL 1.6 FL[a]	0.420 0.049	1 1	– –	7	Roots Tops	< 0.05 0.68, 0.70	IR-4 06308 97-IN02
Florida, US, 1997, (Early Scarlet)	2 FL 1.6 FL[a]	0.420 0.049	1 1	– –	3 7 12	Roots Tops Roots Tops Roots Tops	< 0.05 0.50, 0.54 < 0.05 0.47, 0.53 < 0.05 0.37, 0.40	IR-4 06308 97-FL24
Florida, US, 1997, (Early Scarlet)	2 FL 1.6 FL[a]	0.420 0.049	1 1	– –	6	Roots Tops	< 0.05 0.48, 0.67	IR-4 06308 97-FL25

[a] an organo-silicone surfactant, Kinetic-I, added in the solutions

Carrots

Six field trials were conducted on carrots in Texas, Ohio, California (three trials) and Florida in 1996 (Dorschner, KW 2001d). Each of the field trial sites consisted of one untreated control plot and one treated plot. Each treated plot received one in-furrow application of Admire 2 FL and three or four foliar applications of Provado 1.6 F. The in-furrow application was made at 0.42–0.44 kg ai/ha (with one exception of 0.71 kg ai/ha) at planting and the foliar applications were made 5 to 7 days apart at a total rate of 0.15–0.16 kg ai/ha (with an exception of 0.20 kg ai/ha for four applications due to the slow maturation of the crops). At the four remaining trials, the total amount of imidacloprid applied was 0.58–0.60 kg ai/ha. The first foliar application was made 69 to 130 days after planting, dependent on crop maturity. Kinetic spray adjuvant was included in each foliar spray tank mix. At each trial, duplicate samples of mature carrot roots and tops were collected from each plot 6 to 7 days following the final foliar application.

The LOQ was established at 0.05 mg/kg for carrot roots and tops. The average recoveries were 85% ± 7% in roots and 87% ± 7% in tops at the fortification levels of the LOQ and 83% ± 9% in roots and 87% ± 8% in tops at all fortifications. The maximum storage interval for field-treated samples was 1147 days. In a storage stability test, for control samples fortified to 1.0 mg/kg and stored at < –20°C for 1147 days (roots) or 1132 days (tops), the recoveries obtained were 84–102% for roots and 92–107% for tops.

The registered GAP for imidacloprid application on carrots in the USA is one soil application of Admire 2 FL at 0.175–0.42 kg ai/ha with a PHI of 21 days, or one to three foliar application of Provado 1.6 F at a maximum rate per crop season of 0.15 kg ai/ha with a minimum interval between applications of 5 days and a PHI of 7 days.

Table 14 Summary of imidacloprid residues following soil and foliar application to carrots in the USA

CARROT Country Year (variety)	Formulation	Total application rate (kg ai/ha)	No	Interval (d)	PHI (d)	Commodity	Residue (mg/kg)	Study No
Texas, US, 1996, (Royal Chantenay Rola)	2 FL 1.6 FL[a]	0.706 0.146	1 3	– 6	7	Roots Tops	0.076, 0.09 1.7, 1.9	IR-4 06307 96-TX*27
Ohio, US, 1996, (Comanche)	2 FL 1.6 FL[a]	0.437 0.199	1 4	– 6–7	7	Roots Tops	< 0.05 0.84, 1.4	IR-4 06307 96-OH*20
California, US, 1996, (Caro Pak)	2 FL 1.6 FL[a]	0.444 0.152	1 3	– 5	7	Roots Tops	< 0.05 1.3, 1.9	IR-4 06307 96-CA44
California, US, 1996, (Caro Pak)	2 FL 1.6 FL[a]	0.430 0.147	1 3	– 5	7	Roots Tops	< 0.05 3.8, 4.5	IR-4 06307 96-CA45
California, US, 1996, (Caro Pak)	2 FL 1.6 FL[a]	0.435 0.152	1 3	– 5	7	Roots Tops	< 0.05 3.3, 3.4	IR-4 06307 96-CA46
Florida, US, 1996, (Choctaw)	2 FL 1.6 FL[a]	0.420 0.155	1 3	– 6	6	Roots Tops	< 0.05 0.91, 1.5	IR-4 06307 96-FL54

[a] an organosilicone surfactant, Kinetic-I, added in the solutions

Tree nuts (Almonds and Pecans)

A total of ten field trials (five almonds and five pecans) were conducted in the USA in 1998 (Harbin, AM 2005). Two treated plots were used in each field trial. Two foliar spray applications of Provado 1.6 F were made to the nut trees in each plot at a total rate of 0.39–0.40 kg ai/ha with a 6–9 day interval between applications' beginnings. Different spray volumes were used in the two plots; spray volumes in the 'dilute' plot (Plot 2) ranged from 2900 to 3600 L/ha (with one exception of 790–870 L/ha), while spray volumes in the 'concentrate' plot (Plot 3) ranged from 410–850 L/ha (with the one exception of 220–230 L/ha). All applications were made using ground-based equipment.

Single samples of treated unshelled nuts were collected from each plot at early to normal harvest at a 7–9 day PHI following the second application. In the two decline experiments (one almond and one pecan), additional single samples were collected at 0, 14 and 21 day PHI following the second application. Almonds were separated into nutmeats and hulls.

The LOQ was established as 0.01 mg/kg in almond and pecan nutmeats and 0.02 mg/kg in almond hull. For control samples fortified with equimolar mixtures of imidacloprid and metabolites at 0.01–4.0 mg/kg, the method validation recoveries were 74–108% in almond nutmeat, 83–119% in

pecan nutmeat, and 89–112% in almond hull. The maximum storage interval for field-treated samples was 572 days. No storage stability study was performed.

The registered label for imidacloprid application on tree nuts in the USA is one soil application of Admire 2 FL at 0.28–0.56 kg ai/ha with a PHI of 7 days, or two foliar applications of Provado 1.6 F at a total rate of 0.403 kg ai/ha with a minimum interval between applications of 6 days and a PHI of 7 days. For the foliar use of Provado 1.6 F, the minimum application volume of water is 470 L/ha for ground application, or 230 L/ha for aerial application.

Table 15 Summary of imidacloprid residues following foliar application to almond trees in the USA

TREE NUTS Country Year (variety)	Formulation	Total application rate (kg ai/ha)	Spray volume (L/ha)	No	Interval (d)	PHI (d)	Commodity	Residue (mg/kg)	Study No
California, US, 1998 (Mission)	1.6 FL	0.393	3508–3546	2	7	0 7 14 21	Nutmeat Hull Nutmeat Hull Nutmeat Hull Nutmeat Hull	< 0.01 1.5 < 0.01 1.4 < 0.01 1.2 < 0.01 1.3	IR-4 09220 PO009-98D
California, US, 1998 (Mission)	1.6 FL	0.393	488–537	2	7	0 7 14 21	Nutmeat Hull Nutmeat Hull Nutmeat Hull Nutmeat Hull	< 0.01 0.20 < 0.01 0.23 < 0.01 0.21 < 0.01 0.22	IR-4 09220 PO009-98D
California, US, 1998 (Nonpareil)	1.6 FL	0.392	3446–3453	2	6	7	Nutmeat Hull	< 0.01 2.4	IR-4 09220 PO010-98H
California, US, 1998 (Nonpareil)	1.6 FL	0.394	406–417	2	6	7	Nutmeat Hull	< 0.01 1.4	IR-4 09220 PO010-98H
California, US, 1998 (Nonpareil)	1.6 FL	0.394	3473–3593	2	7	7	Nutmeat Hull	< 0.01 1.5	IR-4 09220 PO011-98H
California, US, 1998 (Nonpareil)	1.6 FL	0.393	416–419	2	7	7	Nutmeat Hull	< 0.01 1.0	IR-4 09220 PO011-98H
California, US, 1998 (Merced)	1.6 FL	0.392	3373–3426	2	7	7	Nutmeat Hull	< 0.01 2.5	IR-4 09220 PO012-98H
California, US, 1998 (Merced)	1.6 FL	0.391	426–455	2	7	7	Nutmeat Hull	< 0.01 1.1	IR-4 09220 PO012-98H
California, US, 1998	1.6 FL	0.392	2979–2999	2	7	9	Nutmeat Hull	< 0.01 2.6	IR-4 09220

TREE NUTS Country Year (variety)	Formulation	Total application rate (kg ai/ha)	Spray volume (L/ha)	No	Interval (d)	PHI (d)	Commodity	Residue (mg/kg)	Study No
(Nonpareil)									PO013-98H
California, US, 1998 (Nonpareil)	1.6 FL	0.393	448–466	2	7	9	Nutmeat Hull	< 0.01 1.9	IR-4 09220 PO013-98H

Table 16 Summary of imidacloprid residues following foliar application to pecan trees in the USA

TREE NUTS Country Year (variety)	Formulation	Total application rate (kg ai/ha)	Spray volume (L/ha)	No	Interval (d)	PHI (d)	Commodity	Residue (mg/kg)	Study No
Georgia, US, 1998 (Summer sly)	1.6 FL	0.392	786–870	2	6	0 7 14 21	Nutmeat Nutmeat Nutmeat Nutmeat	< 0.01 < 0.01 < 0.01 < 0.01	IR-4 09220 PO021-98D
Georgia, US, 1998 (Summer sly)	1.6 FL	0.392	215–234	2	6	0 7 14 21	Nutmeat Nutmeat Nutmeat Nutmeat	< 0.01 < 0.01 < 0.01 < 0.01	IR-4 09220 PO021-98D
Georgia, US, 1998 (Desirable)	1.6 FL	0.398	3418–3438	2	7	7	Nutmeat	< 0.01	IR-4 09220 PO022-98H
Georgia, US, 1998 (Desirable)	1.6 FL	0.396	821–846	2	7	7	Nutmeat	< 0.01	IR-4 09220 PO022-98H
Louisiana, US, 1998 (Jackson)	1.6 FL	0.390	2874–2925	2	7	7	Nutmeat	< 0.01	IR-4 09220 PO023-98H
Louisiana, US, 1998 (Jackson)	1.6 FL	0.392	569–583	2	7	7	Nutmeat	< 0.01	IR-4 09220 PO023-98H
Oklahoma, US, 1998 (Natives)	1.6 FL	0.402	2901–2944	2	7	7	Nutmeat	0.01	IR-4 09220 PO024-98H
Oklahoma, US, 1998 (Natives)	1.6 FL	0.398	627–634	2	7	7	Nutmeat	< 0.01	IR-4 09220 PO024-98H
Oklahoma, US, 1998 (Natives)	1.6 FL	0.386	3455–3512	2	8	7	Nutmeat	< 0.01	IR-4 09220 PO025-98H
Oklahoma, US, 1998	1.6 FL	0.392	604–615	2	8	7	Nutmeat	< 0.01	IR-4 09220 PO025-

TREE NUTS Country Year (variety)	Formulation	Total application rate (kg ai/ha)	Spray volume (L/ha)	No	Interval (d)	PHI (d)	Commodity	Residue (mg/kg)	Study No
(Natives)									98H

Sunflowers

Three seed treatments with Gaucho 480 FS and eight field trials were conducted on sunflowers in the USA in 1997 (McFadden, P 2003). In treatment 1 (Untreated) sunflower seeds were treated only with water and colourant; in treatment 2 (Treated 1×) seeds were treated with Gaucho 480 FS at 9.4 g ai/kg seeds in treatment 3 (Treated 5×) seeds were treated with Gaucho 480 FS at 47 g ai/kg seeds. In order to compensate for the 10% loss from the build up on the sides of the Hege 11 treater (in treated 5×), an additional 10% of the Gaucho 480 FS was added to make the actual rate applied 520 g ai/kg seeds. Untreated and Treated 1× seeds were planted in six locations—Northwood, North Dakota; Britton, South Dakota; Ellendale, North Dakota; Velva, North Dakota; Grand Island, Nebraska; and Claude, Texas. Treated 5× seeds were planted in two locations—Ellendale, North Dakota and Velva, North Dakota. For each location, one control sunflower seed sample and two treated sunflower seed samples were harvested at maturity. For the Nebraska location, there were no samples harvested due to weevil damage.

The LOQ was established as 0.05 mg/kg. Control samples were fortified with equimolar mixtures of imidacloprid and metabolites at 0.05–0.10 mg/kg, the recoveries of 91% ± 6% at LOQ and 86–106% at all fortifications were obtained.

The registered GAP on sunflowers in the USA is seed treatment at a rate of 0.25–0.5 mg ai/seed, which is equivalent to 4.9–9.7 g ai/kg seeds based on 41–62 mg of sunflower seed weight (Ricardo, AR *et al.,* 2006).

Table 17 Summary of imidacloprid residues following seed treatment to sunflower in the USA

SUNFLOWER Country Year (variety)	Formulation	Total application rate (g ai/kg seeds)	Seed treatment	Commodity	Plant harvest Interval (d)	Residue (mg/kg)	Study No
Northwood, North Dakota, US, 1997 (Cargill SF 270)	480 FS	9.38	1×	Seed RAC	129	< 0.05, < 0.05	IR-4 08811
Ellendale, North Dakota, US, 1997 (Cargill SF 270)	480 FS	9.38	1×	Seed RAC	131	< 0.05, < 0.05	IR-4 08811
Ellendale, North Dakota, US, 1997 (Cargill SF 270)	480 FS	46.9	5×	Seed RAC	131	< 0.05, < 0.05	IR-4 08811
Velva, North Dakota, US, 1997 (IS 5757)	480 FS	9.38	1×	Seed RAC	143	< 0.05, < 0.05	IR-4 08811
Velva, North Dakota, US, 1997 (IS 5757)	480 FS	46.9	5×	Seed RAC	143	< 0.05, < 0.05	IR-4 08811
Britton, South Dakota, US, 1997 (Cargill SF 270)	480 FS	9.38	1×	Seed RAC	141	< 0.05, < 0.05	IR-4 08811

SUNFLOWER Country Year (variety)	Formulation	Total application rate (g ai/kg seeds)	Seed treatment	Commodity	Plant harvest Interval (d)	Residue (mg/kg)	Study No
Claude, Texas, US, 1997 (Triumph 546)	480 FS	9.38	1×	Seed RAC	119	< 0.05, < 0.05	IR-4 08811
Grand Island, Nebraska, US, 1997 (Pioneer DE-1998)	480 FS	9.38	1×	–[a]	–	–	IR-4 08811

[a] Seeds destroyed by sunflower weevils

Peanuts

Twelve field trials were conducted on peanuts in the USA during the 1998 to 2000 growing seasons (Dorschner, KW 2006c)—three in Florida, four in Texas, three in Georgia and two in North Carolina. Each field trial consisted of one untreated control plot and one treated plot. One in-furrow application of Admire 2 FL at 0.40–0.43 kg ai/ha was made in planting, after 98–140 days three foliar applications of Provado 1.6 F 4 to 6 days apart at a total rate of 0.14–0.15 kg ai/ha were made. The total amount of imidacloprid applied at each trial was 0.55–0.58 kg ai/ha. An organo-silicone surfactant was added to each foliar spray tank mix.

Single or duplicate samples of peanuts and peanut hay were harvested 13 to 15 days after the final applications. Peanuts and peanut hay were dried in open air or in a dryer, and peanuts, except for those to be used for processing, were then shelled. At the 98-TX18 trial, bulk control and treated peanut samples were collected 14 and 22 days following the final application for processing. In the processing facility, sample processing procedures simulated commercial processing as closely as possible.

The LOQ was statistically calculated as 0.076 mg/kg for nutmeat, 0.032 mg/kg for oil, 0.062 mg/kg for meal and 0.068 mg/kg for hay. For the control samples fortified with equimolar mixtures of imidacloprid and metabolites at 0.05 to 25 mg/kg, method validation recoveries were 69–137% for nutmeat, 86–130% for hay, 77–114% for oil, and 72–114% for meal. The maximum storage interval for field-treated samples was approximately 4 years (1489 days for nutmeat, 1662 days for hay, 1506 days for oil, and 1534 days for meal). Storage stability tests performed after approximately 4.4 years frozen storage (1600 days for both nutmeat and oil, 1609 days for hay, and 1595 days for meal) demonstrated stability with the recoveries of 91–93% in nutmeat, 120–137% in oil, 77–87% in meal, and 72–84% in hay. For hay samples, moisture content ranged from 10 to 20% at most trials. Meal samples generated from peanuts collected at 14 days contained 10 to 20% moisture; samples generated from 22-day peanuts had a moisture content of 8%.

The registered label for imidacloprid application on peanuts in the USA is one soil application of Admire 2 FL at 0.28–0.42 kg ai/ha with a PHI of 14 days or one to three foliar applications of Provado 1.6 F at a maximum rate per crop season of 0.15 kg ai/ha with a minimum interval between applications of 5 days and a PHI of 14 days.

Table 18 Summary of imidacloprid residues following foliar and soil application to peanuts in the USA

PEANUT Country Year (variety)	Formulation	Total application rate (kg ai/ha)	No	Interval (d)	PHI (d)	Commodity	Residue (mg/kg)	Study No
Florida, US, 1998, (Georgia Green)	2 FL 1.6 FL[a]	0.4127 0.1521	1 3	– 4–6	15	Nutmeat Hay	≤ 0.05, < 0.05 0.95	IR-4 06587 98-FL33
Florida, US, 1998, (Georgia Green)	2 FL 1.6 FL[a]	0.4061 0.1504	1 3	– 4–5	13	Nutmeat Hay	≤ 0.05, < 0.05 7.0	IR-4 06587 98-FL34
Florida, US, 1998, (Georgia Green)	2 FL 1.6 FL[a]	0.4035 0.1492	1 3	– 5	14	Nutmeat Hay	≤ 0.05, < 0.05 7.9	IR-4 06587 98-FL35
Texas, US, 1998, (Florunner)	2 FL 1.6 FL[a]	0.4264 0.1463	1 3	– 4–6	14 21 28	Nutmeat Hay Nutmeat Hay Nutmeat Hay	0.15, 0.17 21 0.16, 0.20 20 0.14, 0.10 24	IR-4 06587 98-TX17
Texas, US, 1998, (Florunner)	2 FL 1.6 FL[a]	0.4184 0.1506	1 3	– 5–6	14 22	Nutmeat Hay Oil Meal Nutmeat Oil Meal	0.40,0.31,0.25 9.5 < 0.05 0.62 0.16 < 0.05 0.49	IR-4 06587 98-TX18
Georgia, US, 1999, (NC-V11)	2 FL 1.6 FL[a]	0.4269 0.1515	1 3	– 6	15	Nutmeat Hay	0.08, 0.11 4.1	IR-4 06587 99-GA*21
Georgia, US, 1999, (NC-V11)	2 FL 1.6 FL[a]	0.4308 0.1520	1 3	– 6	15	Nutmeat Hay	0.10, 0.10 4.0	IR-4 06587 99-GA*22
Georgia, US, 1999, (Georgia Green)	2 FL 1.6 FL[a]	0.4201 0.1539	1 3	– 4-6	15	Nutmeat Hay	≤ 0.05, < 0.05, 1.1	IR-4 06587 99-GA23
Texas, US, 1999, (Florunner)	2 FL 1.6 FL[a]	0.4285 0.1513	1 3	– 5	14	Nutmeat Hay	0.13, 0.15 24, 21	IR-4 06587 99-TX20
North Carolina, US, 2000, (VA 98R)	2 FL 1.6 FL[a]	0.4208 0.1393	1 3	– 4–5	13	Nutmeat Hay	0.23, 0.19 12, 11	IR-4 06587 00-NC13
North Carolina, US, 2000, (Gregory)	2 FL 1.6 FL[a]	0.4216 0.1374	1 3	– 4–5	13	Nutmeat Hay	0.12, 0.10 12, 9.7	IR-4 06587 00-NC14
Texas, US, 2000, (Florunner)	2 FL 1.6 FL[a]	0.4238 0.1502	1 3	– 5	14	Nutmeat Hay	0.14, 0.26 23	IR-4 06587 00-TX31

[a] an organo-silicone surfactant, Kinetic-I, added in the solutions

Coffee

Five trials were conducted on coffee in Hawaii in 1997 (Dorschner, KW and Samoil, KS 2003). Five foliar applications of Provado 1.6 F with Kinetic surfactant were applied to mature coffee plants at a total rate of 0.56–0.55 kg ai/ha and an interval of 7 days. Treated and untreated samples of coffee cherries were collected 6–7 days after the last application. Coffee cherries were pulped, fermented for 24 hours, oven-dried for 16 hours, hulled and winnowed to produce green coffee beans. Treated and untreated green bean samples from a trial were further processed into roasted coffee following a period of frozen storage. One untreated roasted sample and one treated roasted sample were then further processed into freeze-dried coffee.

The LOQ was set at 0.01 mg/kg for green beans and roasted beans, and 0.02 mg/kg for freeze-dried beans. Recoveries were 81–128% at 0.01–0.5 mg/kg of the fortification level for green beans, 80–124% at 0.01–0.4 mg/kg for roasted beans, and 67–119% at 0.02–1 mg/kg for freeze-dried beans. Some of the control samples had detectable residues of imidacloprid. Samples were fortified with equimolar mixtures of imidacloprid and its metabolites at 0.2–0.38 mg/kg and stored frozen for 506–779 days. Recoveries were 93–113% in green beans, 90–106% in roasted beans, and 87–94% in freeze-dried beans.

The registered label for imidacloprid application on coffee in the USA is one soil application of Admire 2 FL at 0.28–0.56 kg ai/ha with a PHI of 7 days, or one to five foliar applications of Provado 1.6 F at a maximum rate per crop season of 0.56 kg ai/ha with a minimum interval between applications of 7 days and a PHI of 7 days.

Table 19 Summary of imidacloprid residues following foliar application to coffee in the USA

COFFEE Country Year (variety)	Formulation	Total application rate (kg ai/ha)	No	Interval (d)	PHI (d)	Commodity	Residue (mg/kg)	Study No
Hawaii, US 1997 (Guatemalan)	1.6 FL[a]	0.562	5	7	6	GCB[b] (CK)	0.17, <u>0.19</u> (0.037, 0.034)	IR-4 05760 97-HI01
Hawaii, US 1997 (Red Caturra)	1.6 FL[a]	0.564	5	7	7	GCB (CK)	0.46, <u>0.48</u> (0.030, 0.018)	IR-4 05760 97-HI02
Hawaii, US 1997 (Guatemalan)	1.6 FL[a]	0.566	5	7	6	GCB	<u>0.30</u>, 0.17	IR-4 05760 97-HI03
Hawaii, US 1997 (Yellow Caturra)	1.6 FL[a]	0.561	5	7	7	GCB	<u>0.35</u>, 0.22	IR-4 05760 97-HI04
Hawaii, US 1997 (Yellow Caturra)	1.6 FL[a]	0.564	5	7	7	GCB RCB (CK) FDCB (CK)	0.37 0.16 (0.014) 0.50 (0.057)	IR-4 05760 97-HI05

[a] an organo-silicone surfactant, Kinetic-I, added in the solutions

[b] Coffee: GCB (green coffee bean), RCB (roast coffee bean), FDCB (freeze dried coffee bean)

APPRAISAL

Imidacloprid was evaluated by the JMPR in 2001 for toxicology and in 2002 and 2006 for residues. An ADI of 0–0.06 mg/kg bw/day and an ARfD of 0.4 mg/kg bw/day were established, and numerous maximum residue levels were estimated. The residues were defined by the 2002 JMPR as the sum of imidacloprid and its metabolites containing the 6-chloropyridinyl moiety for both regulatory and dietary intake assessment purposes.

Imidacloprid was scheduled by the 39th session of the CCPR for residue evaluation of additional crops. The Interregional Research Project No. 4 (IR-4) in the USA provided residue data for avocado, banana, blueberry, caneberry, carrot, coffee, pea, peanut, pomegranate, radish, strawberry, sugar apple, sunflower and tree nuts. Japan supplied information on use patterns of imidacloprid on agricultural and horticultural crops and the manufacturer provided labels of products registered in the USA.

Results of supervised residue trials on crops

Berries and other small fruits (except cranberries, grapes and strawberries)

The registered GAP in the USA for blueberries is soil application at a maximal rate of 0.56 kg ai/ha with a PHI of 7 days, and/or a maximum of five foliar applications at a maximum rate of 0.112 kg ai/ha with an interval of 7 days and a PHI of 3 days.

Eleven field trials were conducted, two on low bush blueberry and nine on high bush blueberry. Each of the field trial sites consisted of one untreated control plot and one treated plot, but the three Michigan trials on high bush blueberry used two treated plots each, one for a soil-directed application and the other for foliar applications. Eight of the nine trials on high bush blueberry matched the registered use in the USA. After soil application, the residues were < 0.05 (4), 0.09 mg/kg. After foliar spray, the residues were: 0.38, 0.49, 0.52, 0.89, 1.1, 2.2 and 2.8 mg/kg.

The registered GAP on caneberries (raspberries, blackberries, boysenberries, marionberries) in the USA is soil application at a maximum rate of 0.56 kg ai/ha with a PHI of 7 days, and/or a maximum of three foliar applications at a maximum rate of 0.112 kg ai/ha with an interval of 7 days and a PHI of 3 days. Four field trials were conducted on raspberries which matched the registered use in the USA; the residues were 0.48, 0.49, 0.59, 0.96 mg/kg.

Three field trials with foliar treatment were conducted on blackberries and matched the registered use in the USA; the residues were 0.38, 0.69, 0.70 mg/kg.

One field trial each with foliar treatment was conducted on boysenberries and marionberries and matched the registered use in the USA; the residues were 1.5 and 1.7 mg/kg, respectively.

Based on the blueberry foliar spray residue data, the Meeting estimated a maximum residue level of 5 mg/kg, an STMR of 0.89 mg/kg and an HR of 2.8 mg/kg for the group of berries and other small fruits except cranberries, grapes and strawberries.

Strawberry

The registered GAP on strawberry in the USA is soil application at a maximal rate of 0.56 kg ai/ha with a PHI of 14 days, and/or a maximum of three foliar applications at a maximal rate of 0.053 kg ai/ha with an interval of 5 days and a PHI of 7 days. Nine field trials were conducted; a combination of one soil application matching the registered soil application GAP and three foliar applications matching the registered foliar application GAP was used. Residues were 0.12, 0.14, 0.15 (2), 0.17 (2), 0.21, 0.32, 0.35 mg/kg.

The Meeting estimated an STMR of 0.17 mg/kg and an HR of 0.35 mg/kg, and recommended a maximum residue level of 0.5 mg/kg in strawberry for imidacloprid.

Avocado

The registered GAP on avocado in the USA is soil application at a maximal rate of 0.56 kg ai/ha with a PHI of 6 days, and/or a maximum of five foliar applications at a maximal rate of 0.112 kg ai/ha with an interval of 10 days and a PHI of 7 days. Five field trials were conducted with soil application at 98–104% GAP rate, but with a PHI of 50–69 days, no trials matched the registered GAP in the USA.

The Meeting decided that the trials submitted were inadequate for the purpose of estimating a maximum residue level for avocado.

Banana

The 2002 JMPR evaluated trials from Africa and Central America with an application rate of 0.25 g ai/plant to the base of the pseudo-trunk or with a single basal drench application of 0.21–0.29 g ai/plant and estimated a maximum residue level of 0.05 mg/kg.

New GAP and residue data for banana were submitted in 2008. The GAP in the USA is for a soil application at a maximum rate of 0.56 kg ai/ha with a 0 day PHI, and/or a maximum of five foliar applications at a maximum rate of 0.112 kg ai/ha with a treatment interval of 14 days and a 0 day PHI. Five field trials were conducted with foliar application and matched the registered GAP in the USA, four of them with unbagged and one with bagged bananas. Residues in the whole fruit were 0.44 (2), 0.50, 0.53 mg/kg for unbagged bananas and 0.13 mg/kg for bagged bananas.

The Meeting decided that four trials on unbagged and one on bagged bananas were not sufficient to estimate a maximum residue level and that the previous recommendation of 0.05 mg/kg should be maintained.

Pomegranate

The registered GAP on pomegranate in the USA is for a soil application at a maximum rate of 0.56 kg ai/ha with a 0 day PHI, and/or a maximum of three foliar applications at a maximum rate of 0.112 kg ai/ha with an interval of 7 days and a PHI of 7 days. Three field trials were conducted, a combination of one soil application at 57–63% of the GAP rate and three foliar applications matching the registered foliar application GAP. Residues in whole fruit were 0.42, <u>0.43</u>, 0.55 mg/kg. The Meeting considered three trials adequate for estimation of a maximum residue level for this minor crop.

The Meeting estimated a maximum residue level, an STMR value and an HR value for imidacloprid in pomegranate of 1, 0.43 and 0.55 mg/kg, respectively.

Sugar apple

The registered GAP on sugar apple in the USA is a maximum of five foliar applications at a maximum rate of 0.112 kg ai/ha with a treatment interval of 10 days and a PHI of 7 days. Three field trials were conducted with a PHI of 14/15 days and did not match the registered GAP in the USA

The Meeting decided that the trials submitted were inadequate for the purpose of estimating a maximum residue level for pomegranate.

Radish leaves (including tops)

The registered GAP on radish in the USA is one soil application at a maximum rate of 0.42 kg ai/ha with a PHI of 21 days, and/or one foliar application at a maximal rate of 0.049 kg ai/ha with a PHI of 7 days. Five field trials were conducted, a combination of one soil application matching the registered soil application GAP and one foliar application matching the registered foliar application GAP. Residues in radish leaves (including tops) were 0.53, 0.67, <u>0.70</u>, 1.8 and 2.7 mg/kg.

The Meeting estimated a maximum residue level, an STMR value and an HR value for imidacloprid in radish leaves of 5, 0.7 and 2.7 mg/kg, respectively.

Peas (pods and succulent, immature seeds)

The registered GAP on pea in the USA is seed treatment at a maximal rate of 1.116 g ai/kg seeds, and/or soil application at a maximal rate of 0.42 kg ai/ha with a PHI of 21 days, and/or a maximum of three foliar applications at a maximal rate of 0.049 kg ai/ha with an interval of 7 days and a PHI of 7 days. Four field trials were conducted, a combination of one seed treatment with 200% GAP rate, one soil application matching the registered soil application GAP and three foliar applications matching the registered foliar application GAP. Residues were 0.20, 0.27, 0.92, 3.8 mg/kg.

The Meeting estimated a maximum residue level, an STMR value and an HR value for imidacloprid in peas (pods and succulent, immature seeds) of 5, 0.60 and 3.8 mg/kg, respectively.

Peas, shelled (succulent seeds)

The registered GAP on pea in the USA is seed treatment at a maximal rate of 1.116 g ai/kg seeds, and/or soil application at a maximal rate of 0.42 kg ai/ha with a PHI of 21 days, and/or a maximum of three foliar applications at a maximal rate of 0.049 kg ai/ha with an interval of 7 days and a PHI of 7 days. Six field trials were conducted, a combination of one seed treatment with 200% GAP rate, one soil application matching the registered soil application GAP and three foliar applications matching the registered foliar application GAP. Residues were 0.31, 0.42, 0.54, 0.62, 0.88 and 1.1 mg/kg.

The Meeting estimated a maximum residue level, an STMR value and an HR value for imidacloprid in peas (succulent, shelled) of 2, 0.58 and 1.1 mg/kg, respectively.

Peas (dry)

The registered GAP on pea in the USA is seed treatment at a maximal rate of 1.116 g ai/kg seeds, and /or soil application at a maximal rate of 0.42 kg ai/ha with a PHI of 21 days, and/or a maximum of three foliar applications at a maximum rate of 0.049 kg ai/ha with an interval of 7 days and a PHI of 7 days. Six field trials were conducted, a combination of one seed treatment at 2× GAP rate, one soil application matching the registered soil application GAP and three foliar applications matching the registered foliar application GAP. Residues were 0.14, 0.2, 0.32, 0.91, 0.94, and 1.0 mg/kg in dry shelled peas.

The Meeting estimated a maximum residue level for imidacloprid in peas (dry) of 2 mg/kg and an STMR of 0.62 mg/kg, respectively.

Root and tuber vegetables

The 2002 JMPR evaluated residue supervised trials data for imidacloprid on potatoes and sugar beet. New residue data were submitted to the current Meeting for carrots and radish.

Carrot

The registered GAP on carrot in the USA is for soil application at a maximum rate of 0.42 kg ai/ha with a PHI of 21 days, and/or a maximum of three foliar applications at a maximal rate of 0.049 kg ai/ha with an interval of 5 days and a PHI of 7 days. Six field trials were conducted involving a combination of one soil application, matching the registered soil application GAP (with trial 96-TX*27 an exception at 168% GAP rate), and one foliar application matching the registered foliar application GAP (with trial 96-OH*20 an exception at 135% GAP rate). The data from these trials were used for the evaluation and the residues were < 0.05 (5), 0.09 mg/kg.

Radish

The registered GAP on radish in the USA is one soil application at a maximal rate of 0.42 kg ai/ha with a PHI of 21 days, and/or one foliar application at a maximal rate of 0.049 kg ai/ha with a PHI of 7 days. Five field trials were conducted, a combination of one soil application matching the registered soil application GAP and one foliar application matching the registered foliar application GAP. Residues were < 0.05 (4), 0.13 mg/kg in roots.

Potato

The 2002 JMPR estimated a maximum residue level, an STMR and an HR for imidacloprid in potatoes of 0.5, 0.05 and 0.28 mg/kg, respectively.

Sugar beet

The 2002 JMPR estimated a maximum residue level and an STMR for imidacloprid in sugar beet of 0.05* mg/kg and 0.05 mg/kg.

The Meeting estimated a maximum residue level, an STMR and an HR for imidacloprid in root and tuber vegetables of 0.5, 0.05 and 0.28 mg/kg, respectively, based on the potato residue data, i.e., commodity with the highest residues in the crop group. The Meeting agreed to withdraw it previous recommendations for potatoes of 0.5 mg/kg and for sugar beet of 0.05* mg/kg.

Tree nuts

The registered GAP on tree nuts in the USA is for a soil application at a maximum rate of 0.56 kg ai/ha with a PHI of 7 days, and/or a maximum of four foliar applications at a maximal application (per season) of 0.403 kg ai/ha with an interval of 6 days and a PHI of 7 days. Ten field trials each were conducted on almonds and pecans. These trials matched the registered GAP in the USA. Residues were < 0.01 (19) and 0.01 mg/kg in the almond and pecan nutmeat (kernels).

The 2002 JMPR recommended a maximum residue level of 0.05 mg/kg for pecan based on supervised residue trials from the USA carried out in 1993 and 1998. The residue data of the trials carried out in1998 were submitted to the 2008 JMPR. The Meeting noted that the LOQ for the determination of imidacloprid in pecan nutmeat from the 1993 trials was 0.05 mg/kg whereas it was 0.01 mg/kg for the 1998 trials and decided to estimate the maximum residue level on the basis of the 1998 residue data only.

The Meeting estimated a maximum residue level, an STMR value and an HR value for imidacloprid in tree nuts of 0.01*, 0.01 and 0.01 mg/kg, respectively. The Meeting agreed the previous recommendation of a maximum residue level of 0.05 mg/kg for pecan should be withdrawn.

Sunflower seed

The registered GAP on sunflower in the USA is as a seed treatment at a maximum rate of 0.5 mg ai/seed equivalent or 9.7 g ai/kg seeds. Five field trials were conducted according to GAP with a treatment of 9.38 g ai/kg seeds. In two further trials the application rate was 46.9 g ai/kg seeds. The residues found in the seeds, following a harvest interval of 119–143 days, were: < 0.05 (7) mg/kg.

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

Peanuts

The registered GAP on peanut in the USA is for a soil application at a maximum rate of 0.42 kg ai/ha with a PHI of 14 days, and/or a maximum of three foliar applications at a maximum rate of 0.049 kg ai/ha with an application interval of 5 days and a PHI of 14 days. Twelve field trials were conducted consisting of a combination of one soil application, matching the registered soil application GAP, and three foliar applications, matching the registered foliar application GAP. Residues in the peanut kernels were < 0.05 (4), 0.10, 0.11, 0.12, 0.15, 0.17, 0.23, 0.26, 0.40 mg/kg.

The Meeting estimated a maximum residue level, an STMR value and an HR value for imidacloprid in peanuts of 1, 0.12 and 0.4 mg/kg, respectively.

Coffee

The registered GAP on coffee in the USA is soil application at a maximum rate of 0.56 kg ai/ha with a PHI of 7 days, and/or a maximum of five foliar applications at a maximum rate of 0.112 kg ai/ha with

an application interval of 7 days and a PHI of 7 days. Five trials were conducted complying with the GAP of the USA. Residues were: 0.19, 0.30, 0.35, 0.37 and 0.48 mg/kg in green coffee beans.

The Meeting recommended a maximum residue level of 1 mg/kg for imidacloprid in green coffee beans. The Meeting also estimated an STMR of 0.35 mg/kg.

Primary animal feed commodities

Almond hulls

The registered GAP on tree nuts (almond) in the USA is soil application at a maximal rate of 0.56 kg ai/ha with a PHI of 7 days, and/or a maximum of four foliar applications at a maximal application (per season) of 0.403 kg ai/ha with an interval of 6 days and a PHI of 7 days. Ten field trials were conducted on almonds. These trials matched the registered GAP in the USA. The residues were in rank order 0.23, 1.0, 1.1, 1.4 (2), 1.5, 1.9, 2.4, 2.5 and 2.6 mg/kg in almond hulls (fresh weight basis).

Allowing for the standard 90% dry matter, the Meeting estimated a maximum residue level and an STMR value for imidacloprid in almond hulls of 5 mg/kg and 1.7 mg/kg, respectively.

Peanut fodder

The registered GAP on peanut in the USA is soil application at a maximal rate of 0.42 kg ai/ha with a PHI of 14 days, and/or a maximum of three foliar applications at a maximal rate of 0.049 kg ai/ha with an interval of 5 days and a PHI of 14 days. Twelve field trials were conducted, consisting of a combination of one soil application matching the registered soil application GAP and three foliar applications matching the registered foliar application GAP. The residues were in rank order 0.95, 1.1, 4.0, 4.1, 7.0, 7.9, 9.5, 12 (2), 21, 23 and 24 mg/kg in peanut fodder (fresh weight basis).

Allowing for the standard 85% dry matter, the Meeting estimated a maximum residue level, an STMR value and highest residue for imidacloprid in peanut fodder of 30 mg/kg, 10.2 mg/kg and 28 mg/kg, respectively.

Residues in animal commodities

Estimated maximum and mean dietary burdens of farm animals

Dietary burden calculations based on the feed items evaluated by the JMPR in 2002 and 2008 for beef cattle, dairy cattle, broilers and laying poultry are presented in Annex 6 of the 2008 Report of the JMPR. The calculations were made according to the livestock diets from US-Canada, EU and Australia in the OECD Table (Annex 6 of the 2006 JMPR Report).

	Livestock dietary burden, imidacloprid, ppm of dry matter diet					
	US-Canada		EU		Australia	
	max	mean	max	mean	max	mean
Beef cattle	8.29	2.64	2.29	0.78	18.01	6.07
Dairy cattle	7.16	2.30	2.38	0.93	18.01[a]	6.14[b]
Poultry - broiler	0.18	0.28	0.46	0.26	0.12	0.12
Poultry - layer	0.19	0.28	1.02[c]	0.37[d]	0.09	0.12

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

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

[c] Highest maximum poultry broiler or layer burden suitable for MRL estimates for poultry meat and eggs

[d] Highest mean poultry broiler or layer burden suitable for STMR estimates for poultry meat and eggs

Animal commodity maximum residue levels

Because of the changes in the animal dietary burden, the residue concentrations in animal products were re-calculated by the 2008 JMPR.

Cattle

A feeding study on dairy cows dosed with imidacloprid in capsules at the equivalent of 5, 15 or 50 ppm in the diet for 28 days was submitted to the 2002 JMPR. The 2002 Meeting estimated mean transfer factors (concentration of residue ÷ concentration in feed) for cattle tissues and milk as follows: liver 0.01, kidney 0.006, muscle 0.002, fat 0.0012 and milk 0.0029.The Meeting agreed to apply the transfer factors to maximum and mean dietary burdens calculated by the 2008 JMPR (transfer factor × dietary burden in mg/kg feed).

The maximum concentrations of residues expected in tissues and milk based on a dietary burden of 18.01 ppm are: 0.18 mg/kg in liver, 0.11 mg/kg in kidney, 0.04 mg/kg in muscle, 0.02 mg/kg in fat and 0.05 mg/kg in milk.

The mean concentrations of residues expected in tissues and milk based on a dietary burden of 6.14 ppm are: 0.06 mg/kg in liver, 0.04 mg/kg in kidney, 0.012 mg/kg in muscle, 0.007 mg/kg in fat and 0.018 mg/kg in milk.

The Meeting estimated maximum residue levels of 0.1 mg/kg for meat (mammalian), 0.3 mg/kg in edible offal (mammalian) and 0.1 mg/kg in milks. The previous recommendation for 0.02* mg/kg for meat (mammalian) and milks, as well as 0.05 mg/kg for edible offal, should be withdrawn.

The Meeting recommended that the HR values should be 0.04 mg/kg in meat (mammalian), 0.18 mg/kg in edible offal (mammalian), and 0.02 mg/kg in fat (mammalian). The estimated STMR values are 0.012 mg/kg for meat (mammalian), 0.06 mg/kg for edible offal (mammalian), 0.007 mg/kg for fat (mammalian) and 0.018 mg/kg for milks.

Poultry

A feeding study on laying hens dosed with imidacloprid at the equivalent of 2, 6 or 20 ppm in the diet for 30 days was submitted to the 2002 JMPR. The 2002 Meeting estimated mean transfer factors (concentration of residue ÷ concentration in feed) for poultry tissues and eggs as follows: liver 0.02, muscle 0.0027, fat 0.001 and eggs 0.007.The Meeting agreed to apply the transfer factors to maximum and mean dietary burdens calculated by the 2008 JMPR (transfer factor • dietary burden in mg/kg feed).

The maximum concentrations of residues expected in poultry tissues and eggs based on a maximum dietary burden of 1.02 ppm are: 0.02 mg/kg in liver, 0.003 mg/kg in muscle, 0.001 mg/kg in fat and 0.007 mg/kg in eggs.

The mean concentrations of residues expected in poultry tissues and eggs based on a mean dietary burden of 0.37 ppm are: 0.007 mg/kg in liver, 0.001 mg/kg in muscle, 0.0004 mg/kg in fat and 0.003 mg/kg in eggs.

The Meeting estimated maximum residue levels of 0.02 mg/kg for eggs and poultry meat and confirmed its previous recommendation. For poultry edible offal a maximum residue level of 0.05 mg/kg was estimated. The previous recommendation of 0.02* mg/kg for poultry edible offal should be withdrawn.

The Meeting recommended that the HR values should be 0.003 mg/kg in poultry meat, 0.02 mg/kg in poultry edible offal, 0.001 mg/kg in poultry fat and 0.007 mg/kg in eggs. The estimated STMR values are 0.001 mg/kg for poultry meat, 0.007 mg/kg for edible offal, 0.0004 mg/kg for poultry fat and 0.003 mg/kg for eggs.

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 dietary intake assessment.

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

Sum of imidacloprid and its metabolites containing the 6-chloropyridinyl moiety, expressed as imidacloprid.

CCN	Commodity	Recommended MRL, mg/kg		STMR, mg/kg	HR, mg/kg
		New	Previous		
AM 0660	Almond hulls	5[a]		1.7	
FB 0018	Berries and small fruits (except cranberries, grapes and strawberries)	5		0.89	2.8
SB 0716	Coffee beans	1		0.35	
MO 0095	Edible offal (Mammalian)	0.3	0.05	0.06	0.18
PE 0112	Eggs	0.02	0.02	0.003	0.007
ML 0106	Milks	0.1	0.02*	0.018	
MM 0095	Meat (from mammals other than marine mammals)	0.1	0.02*	0.012 (muscle) 0.007 (fat)	0.04 (muscle) 0.02 (fat)
VD 0072	Pea (dry)	2		0.62	
VP 0063	Peas (pods and succulent = immature seeds)	5		0.60	3.8
VP 0064	Pea, shelled (succulent seeds)	2		0.58	1.1
SO 0697	Peanut	1		0.12	0.40
TN 0672	Pecan	W	0.05		
FI 0355	Pomegranate	1		0.43	0.55
VR 0589	Potato	W	0.5		
PM 0110	Poultry meat	0.02	0.02	0.001 (muscle) 0.0004 (fat)	0.003 (muscle) 0.001 (fat)
PO 0111	Poultry edible offal of	0.05	0.02*	0.007	0.02
VL 0494	Radish leaves (including Radish tops)	5		0.70	2.7
VR 0075	Root and tuber vegetables	0.5		0.05	0.28
FB 0275	Strawberry	0.5		0.17	0.35
VR 0596	Sugar beet	W	0.05*		
SO 0702	Sunflower seed	0.05*		0.05	
TN 0660	Tree nuts	0.01		0.01	0.01
AL 0697	Peanut fodder	30 [a]		10.2 [a]	28 [a]

[a] on dry matter basis

DIETARY RISK ASSESSMENT

Long-term intake

The International Estimated Daily Intakes (IEDI) of imidacloprid were estimated for the 13 GEMS/Food cluster diets based on 65 commodities. The results are shown in Annex 3 of 2008 Report of the JMPR.

The IEDI for the 13 GEMS/Food cluster diets was 1–5% of the maximum ADI of 0.06 mg/kg bw. The Meeting concluded that the long-term intake of residues of imidacloprid from uses that have been considered by the JMPR is unlikely to present a public health concern.

Short-term intake

The International Estimated Short-term Intake (IESTI) of imidacloprid was calculated for the food commodities for which maximum residue levels, STMRs and HRs were estimated by the current Meeting and for which consumption data was available. The results are shown in Annex 4 of 2008 Report of the JMPR.

The Meeting noticed the very high consumption for black currants of 1054 g for children in the UK with a body weight of 14.5 kg in the large portion and recommended confirmation of this figure.

The IESTI represented for the general population 0–10% and for children 0–50% of the ARfD (0.4 mg/kg bw). The Meeting concluded that the short-term intake of residues of imidacloprid from uses considered by the current Meeting was unlikely to present a public health concern.

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