GLYPHOSATE (158)

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EXPLANATION

Glyphosate is a widely used non-selective herbicide. Glyphosate was first evaluated for toxicology and residues by the JMPR in 1986. It was further evaluated for residues on multiple occasions by the JMPR including a periodic review of residues in 2005.

The toxicology of glyphosate was re-evaluated by the 2011 JMPR which established a group ADI of 0–1 mg/kg bw for the sum of glyphosate, N-acetyl glyphosate, AMPA and N-acetyl-AMPA. The same Meeting confirmed that an ARfD was unnecessary.

Definition of the residue for compliance with MRL (for plant commodities): for soya bean, maize and rape: *sum of glyphosate and N-acetyl-glyphosate, expressed as glyphosate*, and for other crops - *glyphosate*.

Definition of the residue for compliance with MRL for animal commodities: *sum of glyphosate and N-acetyl-glyphosate, expressed as glyphosate*.

The residue definition for estimation of dietary exposure for plant and animal commodities: *glyphosate, N-acetyl-glyphosate, AMPA and N-acetyl AMPA, expressed as glyphosate*.

The residue is not fat soluble.

Glyphosate was scheduled at the Fiftieth Session of the CCPR for the evaluation of additional uses by the 2019 Extra JMPR. The current Meeting received information on analytical methods for lentil, storage stability, use patterns and supervised residue trials on conventional varieties of lentil, bean dry and tree nuts.

RESIDUE ANALYSIS

Analytical methods

The current Meeting received several concurrent method validation tests for confirming the method performance. Two analytical methods were used in trials: ME-1466-3 (2016) applied in lentils, and Method 2, reviewed by the 2005 JMPR, in tree nut, pea dry and beans dry.

In Method 2, the samples were analysed by HPLC-FLD. The LOQs were 0.05 mg/kg for both residues of glyphosate and AMPA in most plant matrices.

In method ME-1466-3, the milled matrix was weighed into 96-well tubes followed by the addition of a 0.1% formic acid solution containing both glyphosate and AMPA stable isotope labeled internal standards. The samples are capped and agitated on a high-speed shaker for extraction then centrifuged. Place plate on centrifuge and spin to clear suspended materials from the liquid column and form a solid pellet (e.g., 10 minutes at 6000 G). An aliquot of the extract is then transferred to a new 96-well plate for analysis by LC-MS/MS, using a cation exchange column and with electrospray ionization. The working range of the method without sample dilution is from 0.03 to 6.0 mg/kg, with LOQs of 0.05 mg/kg and RSDs of 0.8–4.9% for both glyphosate and AMPA.

Average recoveries at several fortification levels in the trials generally fell within the 80–120% range, and with relative standard deviations less than 10%. Information on the validation recovery rates in different commoditieis summarized below.

Table 1 Glyphosate and AMPA analytical validation recovery rate in method ME-1466-03.

Matrix	Method	Analyte (Precursor/Product Ions, m/z)	Fortification level (mg/kg)	n	Recovery (%) （Average）	RSD （%）	Reference
Soya bean	ME - 1466-03	Glyphosate (168/63) Quantitation	0.05 0.5	5	102.9-113.3 (107.1) 105.0-109.4 (108.3)	3.7 2.3	MSL0029625
		AMPA (110/63) Quantitation	0.05 0.5	5	86.3-97.5 (92.5) 96.4-98.6 (97.4)	4.7 0.9	
Canola	ME - 1466-03	Glyphosate (168/63) Quantitation	0.05 0.5	5	97.0-99.8 (98.5) 100.3-103.7 (101)	1.2 1.4	MSL0029625
		AMPA (110/63) Quantitation	0.05 0.5	5	80.0-95.8 (86.5) 93.6-97.4 (95.8)	7.2 1.6	
Soybean Oil	ME - 1466-03	Glyphosate (168/63) Quantitation	0.05 0.5	5 6	94, 99, 97, 91, 95, 97 (96) 101, 100, 99, 102, 104, 104 (102)	2.8 2.5	MSL0029625
		AMPA (110/63) Quantitation	0.05 0.5	5 6	97, 100, 94, 101, 98, 97 (98) 97, 97, 103, 100, 100, 95 (99)	2.5 2.8	
Corn Oil	ME-1466-03	Glyphosate (168/63) Quantitation	0.05 0.5	6 6	100, 95, 100, 105, 100, 100 (100) 100, 99, 103, 98, 103, 100 (101)	2.9 2.1	MSL0029625
		AMPA (110/63) Quantitation	0.05 0.5	6 6	99, 98, 99, 104, 100, 105 (101) 100, 102, 95, 103, 96, 100 (100)	2.8 3.2	
Canola Oil	ME-1466-03	Glyphosate (168/63) Quantitation	0.05 0.5	5 6	99, 95, 95, 98, 97, 104 (98) 99, 99, 100, 103, 102, 101 (101)	3.2 1.5	MSL0029625
		AMPA (110/63) Quantitation	0.05 0.5	5 6	101, 99, 102, 97, 94, 91 （97） 101, 96, 100, 98, 101, 98 （99）	4.4 1.8	
Corn Meal	ME-1466-03	Glyphosate (168/63) Quantitation	0.05 0.5	5	104, 99, 99, 95, 99, 97 (99) 96, 99, 96, 100, 100, 98 (98)	2.7 1.8	MSL0029625
		AMPA (110/63) Quantitation	0.05 0.5	5	98, 111, 101, 106, 92, 94 (101) 110, 102, 106, 98, 93, 107 (103)	7.4 6.0	
Corn Meal	ME-1466-03	Glyphosate (168/63) Quantitation	0.05 0.5	5 6	99, 96, 92, 96, 94, 96 (95) 99, 102, 97, 100, 101, 106 (101)	2.3 3.0	MSL0029625
		AMPA (110/63) Quantitation	0.05 0.5	5 6	111, 112, 103, 98, 108, 96 (105) 104, 96, 103, 102, 103, 102 (102)	6.2 2.8	
		AMPA (110/63) Quantitation	0.05 0.5	12 6	103, 92, 98, 95, 97, 103, 108, 103, 90, 106, 90, 95 (98) 106, 100, 93, 99, 93, 96 (98)	6.3 5.0	

USE PATTERNS

The Meeting received additional information on authorised uses on legume vegetables in the UK and the USA, and tree nuts in USA.

The national critical GAPs for these crops are summarized in the following table. Note that the application rates throughout this report are expressed in terms of glyphosate acid.

Table 2 Registered uses of glyphosate (water-soluble concentrate formulation)

Crop	Country	Application			Max application per season		PHI (days)	Comments
		Method	kg ai/ha (max)	Water L/ha	no	kg ai/ha		
Peas (dry), Lentils Chickpeas	USA	Pre-emergence	4.2	28 – 374				Do not graze or feed to livestock
		Pre-harvest	2.5	93-187	1		7	
Beans (dry)	USA	Pre-emergence	4.2	28-374				Do not graze or feed to livestock
		Pre-harvest	0.87	28-187	1		7	
Beans (field)	UK	Pre-emergence	0.54		1			
		Pre-harvest	1.44	80-250	1		7	
Tree nuts	USA	Directed*	4.2	28-234		8.8	3	14 day PHI for coconut
		Broadcast	1.7	28-234			21	Suppression of grasses.

* Directed spray between and within rows.

Label for tree nuts covers: Almond; Beechnut; Betelnut; Brazil nut; Butternut; Cashew; Chestnut; Chinquapin; Coconut; Filbert (hazelnut); Hickory nut; Macadamia; Pecan; Pine nut; Pistachio; Walnut (black, English)

RESULTS OF SUPERVISED RESIDUE TRIALS ON CROPS

The Meeting received information on supervised field trials involving foliar treatments of glyphosate to lentil, peas dry, beans dry, almond, pecan, and walnut.

Group		Crop	Countries	Table no
015B	Subgroup of dry peas	Lentil (dry)	Canada and USA	3
015A	Subgroup of dry beans	Beans (dry)	USA	4
022	Tree nuts	Almond	USA	5
022	Tree nuts	Pecan	USA.	6
022	Tree nuts	Walnut	USA	6

Results from replicated field plots are listed and mean values are calculated. The results from trials used for the estimation of maximum residue levels (underlined) have been rounded to two significant digits. Residue values were selected for estimating maximum residue levels and for dietary exposure assessment at longer PHI instead of that at the GAP, if those values were found to be higher. The highest residue was selected from trials which were considered to be not independent.

Pulses

Lentil

In eleven lentil trials, two applications of glyphosate (SL) were applied, the first as a pre-emergence application and the second as a pre-harvest application. Samples of seed were stored frozen for up to 5 months before analysis using method ME 1466-03. Concurrent recovery rates in samples spiked with 0.05-20 mg/kg glyphosate or AMPA ranged from 96 -111% (glyphosate) and 93 -113% (AMPA), and the LOQ for both analytes was 0.05 mg/kg.

Table 3 Residues in lentils from supervised trials in Canada and the USA in 2011 involving one pre-emergence and one pre-harvest application of glyphosate (SL formulation).

LENTILS Location (Variety)	Application				Growth Stage	Matrix	DALA	Residues (mg/kg)			Reference & Comments
	N	kg ai/ha		water (L/ha)				glyphosate (mean)	AMPA (mean)	Total	
USA GAP: 1×4.2 kg ai/ha pre-emergence and 1×2.5kg ai/ha pre-harvest, PHI 7 days											
Canada, 2011 Carberry, MB (CDC Imax)	1+ 12	4.25 2.44	4.78 2.77	89 88	pre-emergence BBCH 85–87	Seed	7	2.04 1.96 (2.0)	<0.05 <0.05 (<0.05)	2.0	MSL0029625 Trial-12MB
Canada,2011 Dundurn,SK (CDC Maxim)	1+2 1	4.32 2.51	4.73 2.78	91.4 90.4	pre-emergence BBCH 85–86	Seed	7	0.44 0.39 (0.41)	<0.05 <0.05 (<0.05)	0.41	MSL0029625 Trial-03SK
Canada,2011 Hanley, SK (CDC Maxim)	1+ 1 2	4.20 2.50	4.72 2.78	89 90	pre-emergence BBCH 87	Seed	7	5.04 5.54 (5.3)	<0.05 <0.05 (<0.05)	5.3	MSL0029625 Trial-04SK
Canada,2011 Kenaston, SK (CDC Maxim)	1+ 1 1+ 1	4.25 2.53	4.72 2.78	90 91	pre-emergence BBCH 87–88	Seed	7	2.33 2.43 1.23 1.30 (1.8)	<0.05 <0.05 <0.05 <0.05 (<0.05)	1.8	MSL0029625 Trial-05SK
Canada,2011 Delisle, SK (CDC Maxim)	1+ 1	4.28 2.40	4.70 2.79	91 86	BBCH 80	Seed	7	0.53 0.23 (0.37)	<0.05 <0.05 (<0.05)	0.37	MSL0029625 Trial-06SK
Canada,2011 Harris, ID (CDC Maxim)	1+ 1	4.35 2.56	4.73 2.78	92 92	pre-emergence BBCH 82	Seed	7	1.08 0.72 (0.90)	<0.05 <0.05 (<0.05)	0.90	MSL0029625 Trial-
Canada,2011 Alvena, SK (CDC Maxim)	1+ 1	4.38 2.38	4.28 2.50	102.4 95.2	pre-emergence BBCH 81	Seed	7	3.70 4.08 1.05 2.77 (2.9)	<0.05 <0.05 <0.05 <0.05 (<0.05)	2.9	MSL0029625 Trial-11SK
USA,2011 Velva, ND (CDC Impala)	1+ 1	4.28 2.53	4.73 2.66	91.4 95.1	pre-emergence R6	Seed	7	5.29 7.26 (6.3)	<0.05 0.06 (0.05)	6.4	MSL0029625 Trial-02ND
USA,2011 Payette, ID (Crimson)	1+ 1	4.42 2.55	4.62 2.68	95.6 95.2	pre-emergence 70% of pods ripe (hard)	Seed	7	2.07 1.70 (1.9)	<0.05 <0.05 (<0.05)	1. 9	MSL0029625 Trial-08ID
USA,2011 Jerome, ID (small browns)	1+ 1	4.26 2.52	4.89 2.93	87.1 85.9	pre-emergence BBCH 88	Seed	7	1.95 1.68 1.21 1.50 (1.6)	<0.05 <0.05 <0.05 <0.05 (<0.05)	1.6	MSL0029625 Trial-09ID
USA,2011 Ephrata, WA (Pardina)	1+ 1	4.28 2.51	6.14 3.57	69.7 70.4	pre-emergence BBCH 88	Seed	7	0.39 0.40 3.38 0.94 (1.3)	<0.05 <0.05 <0.05 <0.05 (<0.05)	1.3	MSL0029625 Trial-10WA

The results from 5 (previously submitted) supervised trials on peas dry in the USA were provided to the Meeting.

Peas dry

In peas dry, the Meeting did not receive new data. In data previously evaluated by the 2011 JMPR glyphosate residues (glyphosate only) in peas dry treated with one pre-emergence application of ca. 2.5 kg/ha and one pre-harvest application of ca. 2.5 kg ai/ha glyphosate (SL) with a 7-day PHI were (n=5): 0.70, 0.77, 1.1, 3.4, and 4.2 mg/kg. .

In five trials on dry peas evaluated by the 2011 JMPR, two applications of glyphosate (SL) were applied, the first as a pre-emergence application and the second as a pre-harvest application. Samples of pea seed were stored frozen for up to 7 months before analysis using Method 2. Concurrent recovery rates in samples spiked with 0.05-10 mg/kg glyphosate ranged from 85–118% (glyphosate) and the LOQ was 0.05 mg/kg.

Table 5 Residues in peas dry from supervised trials in the USA in 1998 involving one pre-emergence and one pre-harvest application of glyphosate (SL formulation)

Trial, Location State; country, year (variety)	Form (g ae/L)[a]	No.[b]	Interval (d)	kg ae/ha[a]	kg ae/hL[a]	date of last treatment, timing	PHI (days)	residues, mg/kg[c] glyphosate	Reference
WA*35, Prosser, Washington, USA, 1998 (Columbian)	SL 360	1 + 1	91	2.45 2.52	1.06 1.81	July 13, 80-85% mature pods, crop height 80-90 cm	7 7 7 13 13 13 21 21 21	0.66 0.73 0.70 0.98 1.1 1.0 1.0 1.2 1.1	IR-4 PR No. A6139 Volume 2 of 2
WA*36, Prosser, Washington, USA, 1998 (Columbian)	SL 360	1 + 1	91	2.49 2.48	1.06 1.80	July 13, 80-85% mature pods, crop height 80-90 cm	7 7 7	0.59 0.81 0.70	IR-4 PR No. A6139 Volume 2 of 2
WA*37, Prosser, Washington, USA, 1998 (Columbian)	SL 360	1 + 1	91	2.54 2.48	1.06 1.80	July 13, 80-85% mature pods, crop height 80-90 cm	7 7 7	0.74 0.80 0.77	IR-4 PR No. A6139 Volume 2 of 2
ND07, Fargo, North Dakota, USA, 1998 (Profi)	SL 360	1 + 1	83	2.42 2.63	2.27 2.28	July 21, mature 85% yellow pods, crop height 80-90 cm	7 7 7 14 14 14 21 21 21	3.6 3.3 3.4 2.9 3.0 3.0 2.8 3.7 3.3	IR-4 PR No. A6139 Volume 2 of 2
ND25, Carrington, North Dakota, USA, 1998 (Grande)	SL 360	1[d]	na[d]	2.48	1.52	August 7, 80% commercially mature, crop height 80-90 cm	7 7 7	6.1[e] 2.2[f] 4.2	IR-4 PR No. A6139 Volume 2 of 2

[a] The active ingredient and all residues are reported as glyphosate free acid equivalents (ae).

[b] The number of applications includes the pre-emergence applications + the post emergence applications as x + y, respectively.

[c] Individual replicate values are shown followed by average of replicates in bold font.

[d] Trial ND25 was performed without the pre-plant soil application

[e] Average of triplicate analysis of single field sample.

[f] Average of duplicate analysis of single field sample.

[Barney, 2005, IR-4 PR No. A6139]. No unusual weather conditions. Treated plot size 31-223 m^2. ATV mounted spray boom with spray volume 107-240 l/ha. Plants were swathed with sickle mower, windrowed and allowed to dry in the field for two days. Plants were collected and trashed. Seed were run through seed clipper. Seeds (10-35 unit not given) were sampled at harvest (BBCH not stated).

Samples were stored frozen for a maximum of 221 days. Samples were analysed using a Chelex® 100 resin extraction followed by HPLC analysis with o-phthalaldehyde (OPA) post column reactor with fluorescence detector. Individual recoveries seed were 85-118%.

Subgroup of dry beans

The results from 13 supervised trials on dry beans in the USA were provided to the Meeting.

Beans dry

In thirteen dry beans trials, two applications of glyphosate (SL) were applied, the first as a pre-emergence application and the second as a pre-harvest application. Samples of seed were stored frozen for up to 6 months before analysis using Method 2. Concurrent recovery rates in samples spiked with 0.05–10 mg/kg glyphosate or AMPA ranged from 85–103% (glyphosate) and 64–98% (AMPA), and the LOQs for both analytes were 0.05 mg/kg.

Table 4 Residues in bean dry from supervised trials in the USA in 2001 involving one pre-emergence and one pre-harvest application of glyphosate (SL formulation)

DRY BEAN Country, year Location (Variety)	Application				Growth Stage	Matrix	DAT	Residues (mg/kg)			Reference & Comments
	N	kg ai/ha	kg ai/hL	water (L/ha)				Glyphosate (mean)	AMPA (mean)	Total (mean)	
USA GAP: 1×4.2 kg ai/ha pre-emergence and 1×2.5kg ai/ha pre-harvest, PHI 7 days											
USA, 2001 Wayne County, NY (Kidney) (Montcalm)	1+ 1	4.20 1.71	4.49 1.79	93 95	Pre-emergence Mature pods	Beans	7	0.19	<0.05	0.19	MSL17194
USA, 2001 Kent County, MI (Cranberry)	1+ 1	4.20 1.68	4.87 2.08	86 81	Pre-emergence Mature pods	Beans	7	<0.05	<0.05	<0.1	MSL17194 Trial- MI-1
USA, 2001 Ottawa County, MI (Navy Avanti)	1+ 1	4.20 1.66	5.13 2.03	82 82	Pre-emergence Mature pods	Beans	7	0.21	<0.05	0.21	MSL17194 Trial- MI-2
USA, 2001, Freeborn County ,MN (Navy Norstar)	1+ 1	4.28 1.66	4.05 1.65	106 101	Pre-emergence Mature podsR8	Beans	7	0.19	<0.05	0.19	Report: MSL17194
USA, 2001 York County, NE (Navy Great Northern)	1+ 1	4.17 1.65	3.94 1.56	106 106	Pre-emergence Mature pods 7days prior to maturity	Beans	1 2 7 13 20	0.96 0.43 0.52 1.75 1.65	<0.05 <0.05 <0.05 <0.05 <0.05	0.96 0.43 0.52 1.75 1.65	MSL17194 Trial- NE-1
USA, 2001 Hall County, NE (Navy Great Northern)	1+ 1	4.23 1.68	3.96 1.64	107 103	Pre-emergence 80% Maturity	Beans	7	10.5	0.12	10.7	MSL17194 Trial- NE-2
USA, 2001 Foster County, ND (Pinto Maverick)	1+ 1	4.21 1.68	5.34 1.60	79 105	Pre-emergence R8, 80% Maturity	Beans	7	0.53	<0.05	0.53	MSL17194 Trial- ND-1
USA, 2001 Eddy County, ND (Pinto Othello)	1+ 1	4.21 1.65	5.41 1.59	78 104	Pre-emergence R8, 80% Maturity pods	Beans	7	0.63	<0.05	0.63	MSL17194 Trial- ND-2
USA, 2001 McHenry County, ND (Pinto Othello)	1+ 1	4.23 1.67	5.29 1.59	80 105	Pre-emergence R8, 80% Maturity pods	Beans	7	0.32	<0.05	0.32	MSL17194 Trial- ND-3

DRY BEAN Country, year Location (Variety)	Application				Growth Stage	Matrix	DAT	Residues (mg/kg)			Reference & Comments
	N	kg ai/ha	kg ai/hL	water (L/ha)				Glyphosate (mean)	AMPA (mean)	Total (mean)	
USA , 2001 Weld County, CO (Pinto Montrose)	1+ 1	4.28 1.68	4.04 1.64	106 103	Pre-emergence Mature pods	Beans	7	2.6	<0.05	2.6	MSL17194
USA, 2001 Cache County, UT (Pinto Montrose)	1+ 1	4.18 1.73	4.48 1.89	93 91	Pre-emergence Mature pods	Beans	7	0.20	<0.05	0.20	MSL17194
USA, 2001 Tulare County, CA (California Blackeye#5)	1+ 1	4.22 1.68	4.47 1.82	94 92	Pre-emergence Mature pods	Beans	7	0.80	<0.05	0.80	MSL17194
USA, 2001 Payette County, ID (Pinto Othello)	1+ 1	4.20 1.73	4.05 1.61	104 107	Pre-emergence Mature pods	Beans	7	0.06	<0.05	0.06	MSL17194

Tree nuts

The results from 11 trials on tree nuts (previously submitted to the 2005 JMPR) conducted in the USA were provided to the Meeting.

Almond, pecan, and walnut

In five almond, three pecan, and three walnut trials, one application of glyphosate (SL) was applied as a directed spray between and within the tree rolls. Samples of tree nut were taken from the ground. The tree nuts were raked into piles and placed in plastic lined buckets for transport to the facility next door for separation into hull and nutmeat samples. The hull and nutmeat samples were placed in a freezer within 24 hours of sampling. Samples were stored frozen for up to 5 months before analysis using Method 2. Concurrent recovery rates in samples spiked with 0.05–1 mg/kg glyphosate or AMPA ranged from 65–112% (glyphosate) and 60–99% (AMPA), and the LOQs for both analytes were 0.05 mg/kg.

Table 5 Residues in tree nuts from supervised trials in the USA in 1989 involving one directed application of glyphosate (SL formulation)

TREE NUTS Country, year Location (Variety)	Application			Growth Stage	Residues (mg/kg) Matrix	DALA	Residues(mg/kg)			Reference & Comments
	no	kg ai/ha	water (L/ha)				Glyphosate	AMPA	Total	
GAP: 1×0.43 – 4.2 kg ai/ha, up to 8.8 kg ai/ha, PHI 3 days										
USA,1989 Fresno, California Almond (Mission)	1	8.91 3.81	280	Mature Trees	Nutmeats Hulls	3/10	0.10/0.07 17.6/7.2	<0.05/<0.05 0.06/0.06	0.1/0.07 17.7/7.3	Report: MSL 11022/11519
USA,1989 Hughson, CA, California Almond (Thompson)	1	8.91 7.43	120	Mature Trees	Nutmeats Hulls	3/10	<0.05/<0.05 0.7/0.8	<0.05/<0.05 0.06/0.06	<0.05/<0.05 0.8/0.9*	Report: MSL 11022/11519
USA,1989 Popular, CA, California Almond (Mission)	1	8.91 3.71	240	Mature Trees	Nutmeats Hulls	3/10	0.58/0.5 12.9/14.9	<0.05/<0.05 <0.05	0.58/0.5 12.9/14.9*	MSL 11022/11519
USA,1989 Porterville, CA Almond (Non Pareil)	1	8.91 3.43	260	Mature Trees	Nutmeats Hulls	3/10	<0.05/0.15 0.6/2.9	<0.05/<0.05 <0.05/0.08	<0.05/0.15* 0.6/3.0*	MSL 11022/11519
USA,1989 Turlock, CA Almond (Thompson)	1	8.91 6.85	130	Mature Trees	Nutmeats Hulls	3/10	0.07/0.05 2.6/1.5	<0.05/<0.05 <0.05/<0.05	0.07/0.05 2.6/1.5	MSL 11022/11519

TREE NUTS Country, year Location (Variety)	Application			Growth Stage	Residues (mg/kg) Matrix	DALA	Residues(mg/kg)			Reference & Comments
	no	kg ai/ha	water (L/ha)				Glyphosate	AMPA	Total	
USA,1989 Hawkinsville, GA Pecan (Stuart)	1	8.91 4.69	190	Mature Trees	Nutmeats	3/10	0.15/0.05	<0.05/<0.05	0.15/0.05	MSL 11022/11519
USA,1989 College Station, Station Pecan (Desirable)	1	8.91 4.69	190	Mature Trees	Nutmeats	3/10	<0.05/<0.05	<0.05/<0.05	<0.05/<0.05	MSL 11022/11519
USA,1989 Messilla, NM Pecan (Berton)	1	8.91 4.69	190	Mature Trees	Nutmeats	3/10	<0.05/<0.05	<0.05/<0.05	<0.05/<0.05	MSL 11022/11519
USA,1989 Fresno, CA Walnut (Franqutte)	1	8.91 3.18	280	Mature Trees	Nutmeats	3/10	0.06/<0.05	<0.05/<0.05	0.06/<0.05	MSL 11022/11519
USA,1989 Hughson, CA Walnut (Hartley)	1	8.91 7.43	120	Mature Trees	Nutmeats	3/10	0.69/0.08	<0.05<0.05	0.69/<0.08	MSL 11022/11519
USA,1989 Popular, CA Walnut (Franqutte)	1	8.91 3.71	240	Mature Trees	Nutmeats	3/10	0.45/0.20	<0.05/<0.05	0.45/0.20	MSL 11022/11519

*The residues at the 10-day PHI are higher.

APPRAISAL

Glyphosate is a widely used non-selective herbicide. Glyphosate was first evaluated for toxicology and residues by the JMPR in 1986. It was further evaluated for residues on multiple occasions by the JMPR including a periodic review of residues in 2005.

The 2011 JMPR established a group ADI of 0–1 mg/kg bw for the sum of glyphosate, N-acetyl glyphosate, AMPA and N-acetyl-AMPA. The same Meeting confirmed that an ARfD was unnecessary.

Definition of the residue for compliance with the MRL (for plant commodities): *for soya bean, maize and rape - sum of glyphosate and N-acetyl-glyphosate, expressed as glyphosate*; and for other crops - *glyphosate*.

Definition of the residue for compliance with the MRL (for animal commodities): *sum of glyphosate and N-acetyl-glyphosate, expressed as glyphosate*.

The residue definition for dietary risk assessment (for plant and animal commodities): *glyphosate, N-acetyl-glyphosate, AMPA and N-acetyl AMPA, expressed as glyphosate.*

The residue is not fat soluble.

Glyphosate was scheduled at the Fiftieth Session of the CCPR for the evaluation of additional uses at the Extra 2019 JMPR. The current Meeting received information on analytical method for lentil, storage stability, use pattern and supervised residue trials on conventional varieties of lentil, bean dry and tree nuts.

Methods of analysis

An HPLC-FLD analytical method used for determining residues of glyphosate and AMPA in pea dry, bean dry, and tree nuts was previously evaluated by the 2005 JMPR. A new analytical method for lentils along with validation data was received by the Meeting. The residues in lentil were extracted with a 0.1% formic acid solution, centrifuged and analysed by LC-MS/MS. The method was validated with LOQs of 0.05 mg/kg for both glyphosate and AMPA in lentils.

Storage stability of residues

In 2005, JMPR confirmed that the glyphosate residues were stable under frozen storage conditions (-20 °C) in/on the following commodities (storage interval in parentheses): beans, rape and linseed (at least 18 months), and soya bean seed (at least 6 months).

All samples in new residue trials were stored frozen for less than 5 months before extraction and analysis.

Results of supervised residue trials on crops

The Meeting received supervised trial data for foliar applications of glyphosate on lentils, bean dry, almond, pecan and walnut.

To calculate the sum of glyphosate and AMPA, expressed as parent equivalents (total residues), the Meeting used the approach agreed at the 2005 JMPR.

"When glyphosate and AMPA were summed, AMPA was converted to glyphosate equivalents (AMPA mg/kg × 1.523). All numerical figures for glyphosate application rates (kg ae/ha) or residue levels (mg/kg) are expressed as glyphosate acid equivalents (molecular weight 169 amu), and do not include any mass amounts for the salt cation (e.g., isopropylamine)."

"If AMPA residues are < 0.05 mg/kg, they are not summed with glyphosate, because they are typically much less than glyphosate residues. If both glyphosate and AMPA are < LOQ, then sum is < LOQ of glyphosate. The exception is where there is evidence that AMPA residues are comparable to glyphosate residues such as for soya beans in which case the residues are summed and if both glyphosate and AMPA residues are < LOQ, the sum is less than the combined LOQs for glyphosate and AMPA. "

The Meeting noted that soya bean is a representative crop for metabolism of pulses and decided extend this approach to pulses.

The table below describes how total residues were calculated for each trial.

Glyphosate (mg/kg)	AMPA (mg/kg)	Total (mg/kg)
<0.05	<0.05	<0.05
<0.05	<0.05	<0.1 (Pulses)
0.05	<0.05	0.05
0.05	0.05	0.13 (0.05+(0.05×1.523))

Dry peas, subgroup of

The critical GAP for dry peas, lentils and chickpeas in the USA is 2 applications of 4.2 kg ai/ha pre-emergence and 2.5 kg ai/ha pre-harvest with a PHI of 7 days.

Trials available for the current Meeting were conducted on lentils (4 from USA and 7 from Canada) approximating GAP in the USA.

Glyphosate residues were (n=11) 0.37, 0.41, 0.90, 1.3, 1.6, 1.8, 1.9, 2.0, 2.9, 5.3, and 6.3 mg/kg. Total residues from these 11 trials in ranked order were (n=11) 0.37, 0.41, 0.90, 1.3, 1.6, 1.8, 1.9, 2.0, 2. 9, 5.3, and 6.4 mg/kg (express as glyphosate).

In 2011, JMPR received five additional field trials on conventional peas (dry) performed in the USA in 1998, matching the US GAP. Glyphosate residues (glyphosate only) in seeds in rank of order

were (n=5): 0.70, 0.77, 1.1, 3.4, and 4.2 mg/kg at DALA 7 days. As the residue of AMPA was below 0.05 mg/kg even when glyphosate residue is 5.3 mg/kg, the Meeting concluded that the residue of AMPA in pea dry were below 0.05 mg/kg.

As the US GAP covers the subgroup of dry peas, the Meeting decided to recommend a maximum residue level for subgroup of dry peas. The data on lentils and peas, dry, were not significantly different according to the Mann-Whitney U test. The Meeting decided to combine the datasets.

Combined residues of glyphosate were: (n=16) 0.37, 0.41, 0.70, 0.77, 0.90, 1.1, 1.3, 1.6, 1.8, 1. 9, 2.0, 2.9, 3.4, 4.2, 5.3 and 6.3 mg/kg. The total residues were: (n=16) 0.37, 0.41, 0.70, 0.77, 0.90, 1.1, 1.3, 1.6, 1.8, 1.9, 2.0, 2.9, 3.4, 4.2, 5.3 and 6.4 mg/kg.

The Meeting estimated a maximum residue level for the subgroup of dry peas at 10 mg/kg, and an STMR at 1.7 mg/kg, and withdrew the previous maximum residue level recommendations for pea dry and lentil of 5 mg/kg.

Dry beans, except soya bean

The critical GAP for dry beans in the UK is one application at 1.44 kg ai/ha pre-harvest with a PHI of 7 days.

Thirteen trials in beans, dry were conducted in the USA at an application rate of 4.20 kg ai/ha pre-emergence and an application rate of 1.71 kg ai/ha pre-harvest with harvest 7 DALA. The Meeting considered that the pre-emergence applications did not contribute significantly to the residue level at harvest.

The data of the glyphosate residues in these trials were (n=13): <0.05, 0.06, 0.19 (2), 0.20, 0.21, 0.32, 0.53, 0.63, 0.80, 1.8, 2.6 and 10 mg/kg. The total residues of glyphosate residues were (n=13): <0.1, 0.06, 0.19(2), 0.20, 0.21, 0.32, 0.53, 0.63, 0.80, 1.8, 2.6 and 11 mg/kg.

The Meeting noted that dry bean is the representative commodity of subgroup of dry beans, and estimated a maximum residue level of 15 mg/kg and a STMR of 0.32 mg/kg for glyphosate on dry beans subgroup (except soya bean). The Meeting withdrew its previous recommendation of 2 mg/kg for beans, dry.

Tree nuts

The critical GAP for tree nuts in the USA is for one or more ground directed applications of 4.2 kg ai/ha up to a total seasonal rate of 8.8 kg ai/ha and a PHI of 3 days.

The 2005 JMPR received trial data for glyphosate on almond, pecan, and walnut from the USA, which included one directed application of 8.9 kg ai/ha with harvest 3 DALA. The residue trials submitted did not match the GAP.

The current Meeting did not receive new residue data. The Meeting concluded that the proportionality approach could not be applied to the available data, thus an estimate of a maximum residue level could not be performed.

Animalfeed commodities

The maximum dietary burdens calculated by the 2005 JMPR for cattle and poultry were 381 ppm for cattle and 22.7 ppm for poultry. The current Meeting calculated the additional contribution to the dietary burdens for cattle and poultry from the residues in pea dry and bean dry represented a minor portion (up to 0.79 ppm) of the dietary burdens calculated by the 2005 JMPR. The Meeting confirmed its previous recommendations for animal commodities.

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 (for plant commodities): for soya bean, maize and rape - sum of glyphosate and N-acetyl-glyphosate, expressed as glyphosate, and for other crops - glyphosate.

Definition of the residue for compliance with the MRL (for animal commodities): sum of glyphosate and N-acetyl-glyphosate, expressed as glyphosate.

Definition of the residue for dietary risk assessment (for plant and animal commodities): glyphosate, N-acetyl-glyphosate, AMPA and N-acetyl AMPA, expressed as glyphosate.

The residue is not fat soluble.

CCN	Commodity Name	Recommended Maximum residue level (mg/kg)		STMR or STMR-P (mg/kg)
		New	Previous	
VD 2066	Subgroup of Dry Peas	10	-	1.7
VD 0072	Peas (dry)	W	5	
VD 0533	Lentils (dry)	W	5	
VD 2065	Subgroup of Dry beans, except soya bean	15	-	0.32
VD 0071	Bean, (dry)	W	2	

DIETARY RISK ASSESSMENT

Long-term dietary exposure

The ADI for glyphosate is 0–1 mg/kg bw. The International Estimated Daily Intakes (IEDIs) for glyphosate were estimated for the 17 GEMS/Food Consumption Cluster Diets using the STMR or STMR-P values estimated by the JMPR. The results are shown in Annex 3 of the 2019 Extra JMPR Report.

The IEDIs ranged from 1–4% of the maximum ADI. The Meeting concluded that long-term dietary exposure to residues of glyphosate from uses considered by the JMPR is unlikely to present a public health concern.

Acute dietary exposure

The 2011 JMPR decided that an ARfD for glyphosate was unnecessary. The Meeting therefore concluded that the acute dietary exposure to residues of glyphosate from the uses considered is unlikely to present a public health concern.

REFERENCES

Reference	Author(s)	Year	Title
A6139	Barney WP.	2005	Glyphosate: Magnitude of the Residue on Pea (Dry). IR-4, Report A6139. Unpublished
	Cheminova Monsanto and Syngenta.	2005	Submission to 2005 FAO Panel of Joint Meeting on Pesticide Residues in Support of Periodic Review of Pesticide Residues Data. Glyphosate (158). Unpublished
MSL0017194	Kurtzweil, M.L., Kunda,	2002	Magnitude of Glyphosate Residues in Dried Shelled Beans Following Pre-harvest Application of Roundup UltraMAX Herbicide. Monsanto Company, Report MSL0017194. USA Unpublished

Reference	Author(s)	Year	Title
MSL0011022	Manning, M.J.	2001	Glyphosate Residues in Almond, Pecan, and Walnut Raw Agricultural Commodities Following Pre-harvest Application of Roundup Herbicide. Monsanto Company, Report MSL0011022. Unpublished
	Monsanto	2011	Submission to 2011 FAO Panel of Joint Meeting on Pesticide Residues in Support of Evaluation of Pesticide Residues Data. Glyphosate (158).
MSL0029625	Mueth, M., Allan, J.M., Kaur, G.	2018	Amended from MSL0023812, Magnitude of Glyphosate Residues in Lentil Raw Agricultural Commodities Following Applications of a Glyphosate-Based Formulation. U. S. and Canadian Trials. Monsanto Company, Report MSL0029625. Unpublished
MLL 30180	Reding MA.	1987	Residual glyphosate and aminomethylphosphonic acid in oilseed rape, beans and peas following application of MON 8762 - MON 8795 and Roundup herbicide, UK 1986 field trials. Monsanto Company, Report MLL 30180. Unpublished
MSL0011519	Steinmetz, J.R., Cowell, J.E.	2001	Addendum to MSL-11022: Glyphosate Residues in Almond, Pecan, and Walnut Raw Agricultural Commodities Following Pre-harvest Application of Roundup Herbicide. Monsanto Company, Report MSL0011519. Unpublished