PHORATE (112)

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EXPLANATION

Phorate is a systemic organophosphate contact insecticide and acaricide that inhibits acetylcholinesterase activity. Residue and analytical aspects of phorate were evaluated by the JMPR in 1977, 1984, 1990, 1991, 1992 and 2005. The evaluation of 2005 was a periodic review. The toxicological review was conducted in 2004, which established an ADI of 0–0.0007 mg/kg bw and an ARfD of 0–0.003 mg/kg bw.

The residue definition for phorate, both for enforcement and for risk assessment for animal and plant commodities, is: the sum of the parent, its oxygen analogue, and their sulfoxides and sulfones, expressed as phorate. The analytical methodology available relies on the oxidation of all phorate-related residues to the common moiety metabolite, phorate oxon sulfone.

During the 2005 periodic review of phorate, the JMPR noted that the acute dietary intake of potato by children aged up to 6 years amounted to 120% of the ARfD. This value represents the IESTI for potato, microwaved with peel. The CCPR decided therefore in 2006 not to advance the maximum residue level in the Codex step system. The CCPR in 2007 was informed that the manufacturers would provide additional data for processed potato in 2008 for evaluation by the 2009 JMPR.

The 2009 JMPR reviewed a new study of processing of potatoes to facilitate a refinement of the risk assessment. The Meeting decided however that the experiment in which frozen potatoes with peel were microwaved does not reflect common practices. The Meeting could also not confirm that the extensive weight loss did not result in an unusual loss of phorate residues. The Meeting decided not to use the results of the new processing study, and confirmed its previous recommendations.

A new (alternative) GAP has become available when phorate was registered in Mexico for use on potatoes. New supervised trials on potatoes were conducted in 2011 based on this GAP to support a Codex MRL on potato.

RESIDUE ANALYSIS

Analytical methods

Potato tuber samples were analysed with method M-1620 (see 2005 JMPR). In summary, phorate and its related metabolites (phorate sulfoxides, phorate oxon, phorate sulfone, and phorate oxon sulfoxides) are oxidized to a common fully oxidized moiety, phorate oxon sulfone and determined by gas chromatography with flame photometric detection (GC-FPD). The validation results of the GC-FPD method are presented in Table 1 [Norris, 2012, AA110702].

Table 1 Recoveries obtained with the GC-FPD method for the determination of phorate-related residues in potato tubers.

commodity	reported LOQ mg/kg	spike level [a] mg/kg	n	% recovery [b] mean	% recovery [b] range	RSD_r (%)	control samples mg/kg (n)	calibration	reference, method
potato tubers	0.048	0.048	3	80	76-84	5	<LOQ	0.1-1.0 µg/ml,	M-1620, GC-FPD
		0.48	3	83	82-83	1		linear,	AA110702

4.8	3	84	80-86	4	R^2=0.998

[a] Fortification solutions consisted of approximately equal concentrations of phorate, phorate oxon, phorate sulfoxide, phorate oxon sulfonide and phorate sulfone

[b] Oxidation efficiency was 79%

USE PATTERN

Phorate is a systemic and contact organophosphorus insecticide/nematicide. It is formulated as a granule for application to crops and soil. It is usually applied once at planting, but in some cases a second application may be necessary at cultivation. Target pests controlled by phorate include aphids, beetles, bugs, coffee cicadas, flies, white grubs, rice hispa, jassids, leafhoppers, leaf miners, maggots, mites, plant hoppers, psyllids, stem borers, thrips, weevils, and worms.

A new (alternative) GAP has become available for registered use of phorate on potatoes in Mexico. Supervised residue trials on potatoes based on this GAP have been conducted in 2011. An original label for this use was available. The use pattern of phorate on potatoes is listed in Table 2.

Table 2 Registered use of an in-furrow soil treatment with granular formulation of phorate

Crop	Country	Form	Application				PHI, days
			Method	Rate kg ai/ha	Spray conc, kg ai/hL	Number	
Potato	Mexico	15 G (150 g ai/kg)	in-furrow, soil incorporation at planting	2.0-2.6	na	1	90

RESIDUES RESULTING FROM SUPERVISED TRIALS ON CROPS

The meeting received information on supervised residue trials of in-furrow soil treatment with phorate for the following crop:

Group	Commodity	Table No
Root and tuber vegetables	Potato	3

The results of the supervised trials are shown in Table 3. Unquantifiable residues are shown as below the reported LOQ (e.g. < 0.048 mg/kg). Residues from the trials conducted according to critical GAP have been used for the estimation of maximum residue levels (MRLs), STMR and HR values. Those results are underlined.

Potato

Eight supervised residue trials were conducted in 2011 at locations representative for the major potato production areas in Mexico. The results are presented in Table 3. The treated plots at all eight trials received a single in-furrow application with a phorate granular formulation (2.55 kg ai/ha) at planting. Plot sizes were 72 m^2 with 8 rows/plot and 5 sub-sections (= 40 sub-sections/plot). No unusual weather conditions were reported. Samples were collected at normal harvest. Two tubers were removed from each of twelve random points within a plot to yield 24 tubers in total which constituted a single sample (weight in kg unknown). Adhering soil was removed using a soft bristled brush and the unwashed raw potato tuber samples were kept frozen at -20 °C for a maximum of 73 days to extraction. The potato tuber samples were analysed with GC-FPD with an LOQ of 0.048 mg/kg. Results were not corrected for concurrent recovery (93–108%, n = 4 fortified at 0.048 and 4.8 mg/kg).

Table 3 Residues of phorate-related residues (oxidizable to phoratoxon sulfone) in potato tubers after a single granular soil treatment at planting

Location, year, (variety)	Form	kg ai/ha	No	method, timing	soil type [a]	DAT	residues, mg/kg	reference
La Esperanza, Mexico, 2011 (Alpha)	15 G	2.6	1	In-furrow at planting (14 June)	sandy loam	102	< 0.048	MX1, AA110702
Tlacotepec, Mexico, 2011 (Fianna)	15 G	2.6	1	In-furrow at planting (15 June)	sand	95	< 0.048	MX2, AA110702
San Felipe Hgo., Mexico, 2011 (Vivaldi)	15 G	2.6	1	In-furrow at planting (21 June)	sandy loam	104	< 0.048	MX3, AA110702
Bosencheve, Mexico, 2011 (Gigant)	15 G	2.6	1	In-furrow at planting (22 June)	sandy loam	104	< 0.048	MX4, AA110702
Dios Padre, Mexico, 2011 (Adora)	15 G	2.6	1	In-furrow at planting (23 June)	sandy loam	103	0.17	MX5, AA110702
San Miguel Balderas, Mexico, 2011 (Lucero)	15 G	2.6	1	In-furrow at planting (25 June)	sand	100	< 0.048	MX6, AA110702
Cicitec, Mexico, 2011 (Fianna)	15 G	2.6	1	In-furrow at planting (26 June)	sandy clay	101	0.048	MX7, AA110702
Conoillas, Mexico, 2011 (Fianna)	15 G	2.6	1	In-furrow at planting (4 July)	sandy clay	95	< 0.048	MX8, AA110702

a no further details available

APPRAISAL

Phorate is a systemic organophosphate contact insecticide and acaricide that inhibits acetylcholinesterase activity. Residue and analytical aspects of phorate were evaluated by the JMPR in 1977, 1984, 1990, 1991, 1992 and 2005. The evaluation of 2005 was a periodic review. The toxicological review was conducted in 2004, which established an ADI of 0–0.0007 mg/kg bw and an ARfD of 0.003 mg/kg bw. The residue definition for phorate, both for enforcement and for risk assessment for animal and plant commodities, is: Sum of the parent, its oxygen analogue, and their sulfoxides and sulfones, expressed as phorate. The total residue is not fat-soluble.

During the 2005 periodic review of phorate, the JMPR noted that the acute dietary intake of potato by children aged up to 6 years amounted to 120% of the ARfD. This value represents the IESTI for potato, microwaved with peel. The CCPR decided therefore in 2006 not to advance the maximum residue level in the Codex step system. The CCPR in 2007 was informed that the manufacturers would provide additional data for processed potato in 2008 for evaluation by the 2009 JMPR.

The 2009 JMPR reviewed a new processing study in potatoes to facilitate a refinement of the risk assessment. The Meeting decided however that the experiment in which frozen potatoes with peel were microwaved did not reflect common practice. The Meeting also could not confirm that the extensive weight loss noted in the study did not result in an unusual loss of phorate residues. The Meeting therefore decided to not use the results of the new processing study, and confirmed its previous recommendations.

Following the registration of phorate in Mexico, information on a new Mexican (alternative) GAP was provided by the manufacturer to enable the assessment of existing and proposed MRLs on potatoes.

Methods of analysis

The Meeting received description and validation data for an analytical method used in the study report.

The method was validated for the determination of phorate and its related metabolites (phorate sulfoxides, phorate oxon, phorate sulfone and phorate oxon sulfoxides) after oxidation to a common fully oxidized moiety, phorate oxon sulfone, in potatoes. Phorate-related residues were determined by gas chromatography with flame photometric detection (GC-FPD) with a LOQ of 0.048 mg/kg.

Stability of pesticide residues in stored analytical samples

The Meeting received no new data on the stability of residues in potatoes. The stability of phorate residues in potatoes was confirmed for 706 days in study data submitted to the 2005 Meeting of the JMPR.

Results of supervised residue trials on crops

The Meeting received supervised trials data for phorate-related residues on potatoes.

Potatoes

Field trials involving phorate treatment on potatoes were conducted in Mexico in 2011. A phorate granular formulation was applied in-furrow at planting, at a rate of 2.55 kg ai/ha.

The GAP in Mexico for phorate on potatoes is for a single in-furrow application at planting at 1.95–2.55 kg ai/ha at PHI 90 days. All field trials conducted in Mexico matched the critical GAP. Total phorate-related residues in potato were: < 0.048, < 0.048, < 0.048, < 0.048, < 0.048, < 0.048, 0.048, 0.17 mg/kg (n = 8).

The Meeting estimated a maximum residue limit of 0.3 mg/kg. The Meeting estimated an STMR value of 0.048 mg/kg and an HR value of 0.17 mg/kg. The Meeting agreed to withdraw the previous recommendation of 0.5 mg/kg and to replace it by the recommendation of 0.3 mg/kg based on alternative GAP from Mexico.

Fate of residues during processing

The Meeting did not receive new information on the fate of phorate-related residues during processing of potatoes.

The 2005 JMPR estimated processing factors (median or best estimate) for potato as indicated below. The 2009 JMPR reviewed a new study of processing but decided not to use the results. Using the HR and the STMR for potato (0.17 mg/kg and 0.048 mg/kg respectively), the Meeting estimated HR-Ps and STMR-Ps for their processed commodities as listed below.

Commodity	Processing factors	STMR-P mg/kg	HR-P mg/kg
Potato chips	< 0.07	0.0034	
Potato granules	2.4	0.12	
Peeled potatoes	0.265	0.013	0.045
Potatoes boiled with peel	0.13	0.006	0.022
Potatoes boiled without peel	0.11	0.005	0.019
Potatoes baked with peel	0.28	0.013	0.048

Commodity	Processing factors	STMR-P mg/kg	HR-P mg/kg
Potatoes baked without peel	0.27	0.013	0.046
French fries	0.38	0.018	
Raw potato peels	0.68	0.033	
Potatoes microwaved with peel	0.36	0.017	0.061

Livestock dietary burden

The Meeting noted that the potato median and highest residues and potato processed commodity median residues did not result in a significant change in livestock dietary burden, therefore having no impact on the 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

Definition of the residue for compliance with the MRL and for dietary risk assessment for plant and animal commodities: *sum of the parent, its oxygen analogue, and their sulfoxides and sulfones, expressed as phorate.*

The Meeting considers the residue not fat-soluble.

CCN	Commodity name	MRL mg/kg new	MRL mg/kg previous	STMR(-P) mg/kg	HR (-P) mg/kg
VR 0589	Potato	0.3	0.5	0.048	0.17
	Potato crisps	-	-	0.0034	
	Potato granules	-	-	0.12	
	Peeled potatoes	-	-	0.013	0.045
	Potatoes boiled with peel	-	-	0.006	0.022
	Potatoes boiled without peel	-	-	0.005	0.019
	Potatoes baked with peel	-	-	0.013	0.048
	Potatoes baked without peel	-	-	0.013	0.046
	French fries	-	-	0.018	
	Potato waste (raw potato peels)	-	-	0.033	
	Potatoes microwaved with peel	-	-	0.017	0.061

DIETARY RISK ASSESSMENT

Long-term intake

The International Estimated Daily Intakes (IEDI) of phorate, based on the STMRs estimated for commodities, for the five GEMS/Food regional diets, were in the range of 10 to 40% of the maximum ADI (0.0007 mg/kg bw), see Annex 3. Since raw potatoes with peel are not consumed in significant amounts, the highest STMR for potato processed commodities (i.e., 0.018 mg/kg for French fries) was used in the IEDI calculations. The Meeting concluded that the long-term intake of residues of phorate resulting from the uses that have been considered by JMPR are unlikely to present a public health concern.

Short-term intake

The International Estimated Short Term Intake (IESTI) for phorate was calculated for food commodities for which maximum residue levels were estimated and for which consumption data was available. The results are shown in Annex 4 of the 2012 JMPR Report.

The IESTI for potatoes using alternative GAP from Mexico represented 0–100% of the ARfD (0.003 mg/kg bw) for children. Since raw potatoes with peel are not consumed in significant amounts, the highest HR for potato processed commodities (i.e., 0.061 mg/kg for microwaved potatoes with peel) was used for the aggregate total large portion values. When the total for raw and processed potatoes is refined using data from other countries, potato microwaved with peel represents 0–60% of the ARfD and potato dried (granules/flakes) represents 0–70% of the ARfD for children. The Meeting concluded that the short-term intake of residues of phorate resulting from the uses that have been considered by the JMPR are unlikely to present a public health concern

REFERENCES

Code	Author	Year	Title, Institute & report number, Submitting manufacturer and report code, GLP/Non-GLP. Published/Unpublished
AA110702	Norris F.A.	2012	Magnitude of phorate-related residues in potatoes grown in Mexico, American Agricultural Services, Inc., Amvac Chemical Corporation AA110702. GLP. Unpublished.