IMAZAMOX (276)

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EXPLANATION

Imazamox is an imidazolinone herbicide used for the control of a wide spectrum of grassy and broadleaf weeds. It was first evaluated by the 2014 JMPR for toxicology and for residues. The 2014 JMPR established an ADI of 0–3 mg/kg bw, and an ARfD of 3 mg/kg bw. The residue definition is imazamox for plant and animal commodities for compliance with MRLs, and the sum of imazamox and CL 263284 for plant and animal commodities for the estimation of dietary intake.

Imazamox was included on the priority list by the CCPR at the 48th Session in 2016 for evaluation for additional MRLs by this Meeting. The current Meeting received information on use patterns and supervised residue trials to support estimation of a maximum residue level for barley.

USE PATTERN

The Meeting received labels in Australia. The authorized uses relevant to the supervised residue trials data submitted to the current Meeting are summarized in Table 1.

Table 1 Registered uses of imazamox relevant to the residue evaluation by the current Meeting

Crop	Country	Formulation		Application				PHI, days
		Type	Conc. of imazamox	Method	Rate kg ai/ha	Volume L/ha	No. max	
Barley (imidazolinone-tolerant)	Australia	SL	33 g/L	Foliar spray	0.012-0.025	Min. 70	1	[a b]

[a] Apply to the crops from the 5 leaf stage to 1st node stage. Do not apply after the 1st node stage (Z31).

[b] Do not graze or cut for forage and fodder for 4 weeks after application.

RESIDUES RESULTING FROM SUPERVISED TRIALS ON CROPS

The Meeting received information on imazamox supervised field trials for the following crops.

Group	Commodity	Table
Cereal grains	Barley	Table 2, 3
Straw, fodder and forage of cereal grains and grasses	Barley forage and straw	Table 4, 5

Imazamox formulation was applied for foliar treatment. Each of the field trial sites generally consisted of untreated control plot and treated plot. Residues, application rates and spray concentrations have generally been rounded to two significant figures.

Residue values from the trials, which have been used for the estimation of maximum residue levels, STMRs and HRs, are underlined.

Laboratory reports included method validation with procedural recoveries from spiking at residue levels similar to those occurring in samples from the supervised trials. Date of analyses and duration of residue sample storage were also provided. Although trials included control plots, no control data are recorded in the tables except when residues were found in samples from control plots. Residue data are not corrected for percent recovery.

Conditions of the supervised residue trials were generally well reported in detailed field reports. Most field reports provided data on the sprayers used, plot size, field sample size and sampling date.

Concentration of the metabolite CL 263284 was expressed as parent imazamox equivalents using conversion factor of 1.048. When calculating the sum of imazamox and CL 263284, for values below LOQ, the LOQ was used for each analyte.

Cereal grains

Barley

Two field trials on imidazolinone-tolerant barley were conducted in Australia during the 2008 growing season. The SL formulation was applied once as broadcast foliar application when the crop was at the 1–2 node growth stage. A small plot harvester was used to collect the grain. Grain samples were collected at typical harvest stage (59 and 68 days after application). The samples were placed into labelled plastic bags, double bagged and placed into freezers.

The method M 3098 was used for analysis of imazamox residues in barley grain samples with LC-MS/MS. Average recoveries of imazamox in grain (0.01–2.0 mg/kg fortification rate) was 89.5 ± 12.4 % (n=6). The limit of quantitation was 0.01 mg/kg.

Table 2 Imazamox residues on imidazolinone-tolerant barley grain from supervised trials in Australia (Allen, 2009: 2009/1130682)

Barley country, year (variety)	Application					DALA Days	Residues, mg/kg	Ref
	Form	kg ai/ha	water, L/ha	Growth Stage	no.			
GAP, Australia	*SL*	*0.012- 0.025*	min. 70	the 5 leaf stage to 1st node stage	*1*			
Australia, 2008 Murchison/ VIC (Clearfield)	SL	0.024	100	1-2 nodes	1	68	<u>≤ 0.01</u>	Sampling to analysis: 101 days
		0.049	100	1-2 nodes	1	68	< 0.01	
Australia, 2008 Roseworthy/ SA (Clearfield)	SL	0.024	100	First node	1	59	<u>≤ 0.01</u>	Sampling to analysis: 122 days
		0.049	100	First node	1	59	< 0.01	

Four field trials on imidazolinone-tolerant barley were conducted in different growing areas in Australia during the 2015 and 2016 growing season to determine the residue level of imazamox in/on barley grain. The SL formulation was applied once when the crop was between end of tillering to first node stage (29–32 BBCH). Grain samples were collected at typical harvest stage, 84–140 days after application.

The Method M 3098 was used for analysis of imazamox residues in barley grain samples with LC-MS/MS. Average recoveries of imazamox were 97 ± 5.4% (n=5, 0.02 mg/kg fortification level) and 105 ± 8.0% (n=5, 0.2 mg/kg fortification level). The LOQ was 0.02 mg/kg.

The method L0188/01 was used for the analysis of imazamox and its metabolite CL 263284 in barley grain. Average recoveries of imazamox were 94 ± 6.0% (n=5, 0.02 mg/kg fortification level) and 97 ± 1.3% (n=5, 0.2 mg/kg fortification level). Average recoveries of CL 263284 were 96 ± 4.1% (n=5, 0.02 mg/kg fortification level) and 92 ± 4.9% (n=5, 0.2 mg/kg fortification level). The LOQ was 0.02 mg/kg for each analyte.

Table 3 Imazamox and its metabolite CL 263284 residues on imidazolinone-tolerant barley grain from supervised trials in Australia (Bower, 2016: 2016/8000282)

Barley country, year (variety)	Application					DALA Days	Residues, mg/kg[a]		
	Form	kg ai/ha	water, L/ha	Growth Stage	no.		Imazamox	CL263284	Imazamox + CL263284
GAP, Australia	*SL*	*0.012-0.025*	min. 70	the 5 leaf stage to 1st node stage	*1*				

Barley country, year (variety)	Application					DALA Days	Residues, mg/kg[a]		
	Form	kg ai/ha	water, L/ha	Growth Stage	no.		Imazamox	CL263284	Imazamox + CL263284
Australia, 2015-2016 Forth/TAS (Scope)	SL	0.025	113	BBCH 31-32	1	84	< 0.02 < 0.02	- < 0.02	- < 0.04
		0.050	111	BBCH 31-32	1	84	0.026 0.024	- 0.032	- 0.058
Australia, 2015 Balliang/VIC (Scope)	SL	0.025	99	BBCH 29-31	1	99	< 0.02 < 0.02	- < 0.02	- < 0.04
		0.050	101	BBCH 29-31	1	99	< 0.02 < 0.02	- < 0.02	- < 0.04
Australia, 2015 Wasleys/SA (Scope)	SL	0.025	101	BBCH 31	1	88	< 0.02 < 0.02	- 0.022	- 0.043
		0.050	101	BBCH 31	1	88	0.021 < 0.02	- 0.070	- 0.091
Australia, 2015 Williams/WA (Scope)	SL	0.025	100	BBCH 30	1	140	< 0.02 < 0.02	- < 0.02	- < 0.04
		0.050	100	BBCH 30	1	140	0.040 0.037	- 0.066	- 0.11

[a] up: Analysed by M 3098, storage period from sampling to analysis was 16-34 days.
down: Analysed by L0188/01, storage period from sampling to analysis was 181-243 days.

Straw, fodder and forage of cereal grains and grasses

Barley forage and straw

Two field trials on imidazolinone-tolerant barley were conducted in Australia during the 2008 growing season. The SL formulation was applied once as broadcast foliar application when the crop was at the 1–2 node growth stage. Forage plants were selected at random from across the plots and cut off at ground level. Samples of forage were collected at 0, 28, 35 and 42 or 49 days after application, from one/two nodes to soft dough stage. A small plot harvester was used to collect the straw specimens. Straw samples were collected at typical harvest stage (59 and 68 days after application). All samples were placed into labelled plastic bags, double bagged and placed into freezers.

The method M 3098 was used for analysis of imazamox residues in barley forage and straw samples with LC-MS/MS. Average recoveries of imazamox in forage and straw (0.01–2.0 mg/kg fortification rate) were 91.8 ± 8.4% and 99.1 ± 7.6%, respectively (n=6). The limit of quantitation was 0.01 mg/kg.

Table 4 Imazamox residues on imidazolinone-tolerant barley forage and straw from supervised trials in Australia (Allen, 2009: 2009/1130682)

Barley country, year (variety)	Application				Growth Stage at harvest	Portion analysed	DALA Days	Residues, mg/kg		Ref
	Form	kg ai/ha	water, L/ha	no.				as received	as dry weight	
GAP, Australia	*SL*	*0.012-0.025*	*min. 70*	*1*	*Do not graze or cut for forage and fodder for 4 weeks after application*					
Australia, 2008 Murchison/ VIC (Clearfield)	SL	0.024	100	1	1-2 node 1-2 node Milky dough Ealy dough Soft dough	Forage	-0 0 28 35 49	< 0.01 0.50 0.04 0.02 < 0.01	< 0.01 4.2 0.31 0.11 < 0.01	Sampling to analysis: 101-169 days
					Grain ripe	Straw	68	< 0.01	< 0.01	
		0.049	100	1	1-2 node 1-2 node Milky dough Ealy dough Soft dough	Forage	-0 0 28 35 49	< 0.01 0.87 0.12 0.05 0.04	< 0.01 8.0 0.93 0.34 0.24	
					Grain ripe	Straw	68	0.01	0.01	
Australia, 2008	SL	0.024	100	1	Z39[a] Z39	Forage	-0 0	< 0.01 0.25	< 0.01 1.9	Sampling to analysis:

Barley country, year (variety)	Application				Growth Stage at harvest	Portion analysed	DALA Days	Residues, mg/kg		Ref
	Form	kg ai/ha	water, L/ha	no.				as received	as dry weight	
Roseworthy/ SA (Clearfield)					Z71[b] Z73[c] Z85[d]		28 35 42	0.04 0.01 < 0.01	0.28 0.04 < 0.01	122-181 days
					Mature	Straw	59	< 0.01	< 0.01	
		0.049	100	1	Z39 Z39 Z71 Z73 Z85	Forage	-0 0 28 35 42	< 0.01 0.82 0.06 0.03 0.02	< 0.01 6.9 0.48 0.18 0.11	
					Mature	Starw	59	< 0.01	< 0.01	

[a] Z39: Flag leaf ligule just visible

[b] Z71: Kernel water ripe (no starch)

[c] Z73: Early milk

[d] Z85: Soft dough

Four field trials on imidazolinone-tolerant barley were conducted in different growing areas in Australia during the 2015 and 2016 growing season to determine the residue level of imazamox in/on barley forage and straw. The SL formulation was applied once when the crop was between end of tillering to first node stage (29–32 BBCH). Samples of forage were collected at 13/14, 27–29, 41/42 and 55/56 days after application. Straw samples were collected at typical harvest stage, 84–140 days after application.

The Method M 3098 was used for analysis of imazamox residues in barley forage and straw samples with LC-MS/MS. Average recoveries of imazamox in forage were 89 ± 6.3% (n=6, 0.05 mg/kg fortification level) and 100 ± 5.4% (n=5, 0.5 mg/kg fortification level). Average recoveries in straw were 91 ± 8.3% (n=5, 0.05mg/kg fortification level) and 94 ± 2.8% (n=5, 0.5mg/kg fortification level). The LOQ was 0.05 mg/kg for forage and straw.

Table 5 Imazamox residues on imidazolinone-tolerant barley forage and straw from supervised trials in Australia (Bower, 2016: 2016/8000282)

Barley country, year (variety)	Application				Growth Stage at harvest	Portion analysed	DALA Days	Residues, mg/kg		Ref.
	Form	kg ai/ha	water, L/ha	no.				as received	as dry weight	
GAP, Australia	*SL*	*0.012-0.025*	*min. 70*	*1*	*Do not graze or cut for forage and fodder for 4 weeks after application*					
Australia, 2015-2016 Forth/TAS (Scope)	SL	0.025	113	1	BBCH 41 BBCH 58-59 BBCH 83 BBCH 87	Forage	14 28 42 56	0.063 < 0.05 < 0.05 < 0.05	0.37 0.096 < 0.05 < 0.05	Sampling to analysis: 17-91 days
					BBCH 97-99	Straw	84	< 0.05	< 0.05	
		0.050	111	1	BBCH 41 BBCH 58-59 BBCH 83 BBCH 87	Forage	14 28 42 56	0.12 0.050 < 0.05 < 0.05	0.72 0.21 0.094 < 0.05	
					BBCH 97-99	Straw	84	< 0.05	< 0.05	
Australia, 2015 Balliang/VIC (Scope)	SL	0.025	99	1	BBCH 29-31 BBCH 37 BBCH 41 BBCH 43	Forage	14 27 42 56	0.16 < 0.05 < 0.05 < 0.05	0.82 0.22 < 0.05 < 0.05	Sampling to analysis: 35-98 days
					BBCH 89	Straw	99	< 0.05	< 0.05	
		0.050	101	1	BBCH 29-31 BBCH 37 BBCH 41 BBCH 43	Forage	14 27 42 56	0.32 0.091 < 0.05 < 0.05	1.7 0.56 0.12 0.14	
					BBCH 89	Straw	99	< 0.05	< 0.05	

Barley country, year (variety)	Application				Growth Stage at harvest	Portion analysed	DALA Days	Residues, mg/kg		Ref.
	Form	kg ai/ha	water, L/ha	no.				as received	as dry weight	
Australia, 2015 Wasleys/SA (Scope)	SL	0.025	101	1	BBCH 33-34	Forage	14	0.073	0.40	Sampling to analysis: 23-117 days
					BBCH 45		29	<u>< 0.05</u>	0.13	
					BBCH 59		41	< 0.05	< 0.05	
					BBCH 75		55	< 0.05	< 0.05	
					BBCH 99	Straw	88	< 0.05	<u>< 0.05</u>	
		0.050	101	1	BBCH 33-34	Forage	14	0.30	1.7	
					BBCH 45		29	0.085	0.36	
					BBCH 59		41	< 0.05	0.091	
					BBCH 75		55	< 0.05	< 0.05	
					BBCH 99	Straw	88	< 0.05	< 0.05	
Australia, 2015 Williams/WA (Scope)	SL	0.025	100	1	BBCH 31-32	Forage	13	0.30	1.8	Sampling to analysis: 21-126 days
					BBCH 33-37		27	<u>0.073</u>	0.51	
					BBCH 37-41		41	< 0.05	0.15	
					BBCH 37-51		55	< 0.05	< 0.05	
					BBCH 99	Straw	140	< 0.05	<u>< 0.05</u>	
		0.050	100	1	BBCH 31-32	Forage	13	0.50	3.7	
					BBCH 33-37		27	0.16	1.3	
					BBCH 37-41		41	0.056	0.41	
					BBCH 37-51		55	< 0.05	< 0.05	
					BBCH 99	Straw	140	< 0.05	< 0.05	

APPRAISAL

Imazamox is an imidazolinone herbicide used for the control of a wide spectrum of grassy and broadleaf weeds. It was first evaluated by the 2014 JMPR for toxicology and for residues. The 2014 JMPR established an ADI of 0–3 mg/kg bw, and an ARfD of 3 mg/kg bw. The residue definition is imazamox for plant and animal commodities for compliance with MRLs, and the sum of imazamox and CL 263284 for plant and animal commodities for the estimation of dietary intake.

Imazamox was included on the priority list by the CCPR at the 48th Session in 2016 for evaluation for additional MRLs by this Meeting. The current Meeting received information on use patterns and supervised residue trials to support estimation of a maximum residue level for barley.

Method of analysis

The analytical method (Method M3098) for the determination of imazamox and CL 263284 was evaluated by the 2014 JMPR. The method is suitable for the residue analysis of imazamox and CL 263284 in barley grain, forage and straw.

Stability of residues in stored analytical samples

Freezer storage stability studies on wheat (grain, straw, forage and hay) samples were evaluated by the 2014 JMPR. Storage stability results indicated that imazamox and CL 263284 residues were stable at ≦ -10 °C for at least 4 years in wheat (grain, straw, forage and hay). The periods of storage stability studies cover the sample storage intervals of residue trials.

Results of supervised residue trials on crops

The Meeting received supervised trial data for the foliar application of imazamox on barley (imidazolinone-tolerant) from Australia.

Barley

The supervised trials were conducted on <u>imidazolinone-tolerant barley</u> in Australia.

The GAP on imidazolinone-tolerant barley of Australia is a foliar application at a maximum rate of 0.025 kg ai/ha from the 5 leaf stage to the 1st node stage.

Imazamox residues in barley grains from independent trials in Australia matching GAP were (n=6): < 0.01 (2) and < 0.02 (4) mg/kg.

Total residues (imazamox + CL 263284) in barley grains from independent trials in Austalia matching GAP were (n=4): < 0.04 (3) and 0.043 mg/kg.

Based on the residues in barley grain from trials in Australia, the Meeting estimated a maximum residue level and an STMR value for imazamox in barley of 0.02 and 0.04 mg/kg respectively.

Animal feedstuffs

Barley forage and straw

Data were available from supervised trials on imidazolinone-tolerant barley in Australia.

The GAP on imidazolinone-tolerant barley in Australia is a foliar application at a maximum rate of 0.025 kg ai/ha from the 5 leaf stage to the 1st node stage and not to graze or cut for forage and fodder for 4 weeks after application.

Imazamox residues in barley forage (as received) from independent trials in Australia matching GAP were (n=6): 0.04 (2), < 0.05 (3) and 0.073 mg/kg.

Based on the residues for barley forage, the Meeting estimated a median residue value and a highest residue value for imazamox in barley forage of 0.05 and 0.073 mg/kg, respectively on an "as received" basis.

Imazamox residues in barley straw (dry weight basis) from independent trials in Australia matching GAP were (n=6): < 0.01 (2) and < 0.05 (4) mg/kg.

Based on the residues in barley straw, the Meeting estimated a maximum residue level of 0.05 mg/kg, a median residue value of 0.05 mg/kg and a highest residue value of 0.05 mg/kg for imazamox in barley straw on a dry weight basis.

Residue in animal commodities

The 2017 JMPR evaluated residues of imazamox in barley, which is listed in the OECD feeding table. The Meeting noted that the estimation did not result in a significant change of the dietary burdens of farm animals (2.4 to 2.4 ppm for cattle and 0.51 to 0.51 ppm for poultry). The previous recommendations of maximum residue level for animal commodities were maintained.

RECOMMENDATIONS

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

Definition of the residue for plant and animal commodities for compliance with the MRL:

Imazamox.

Definition of the residue for plant and animal commodities for estimation of dietary intake:

Sum of imazamox and 5-(hydroxymethyl)-2-(4-isopropyl-4-methyl-5-oxo-2-imazazolin-2-yl) nicotinic acid (CL 263284), expressed as imzamox.

The residue is not fat soluble

Commodity		Recommended MRL, mg/kg		STMR or STMR-P, mg/kg	HR or HR-P, mg/kg
CCN	Name	New	Previous		
GC 0640	Barley	0.02		0.04	

Commodity		Recommended MRL, mg/kg		STMR or STMR-P, mg/kg	HR or HR-P, mg/kg
CCN	Name	New	Previous		
AS 0640	Barley straw and fodder, dry	0.05 (DW)		0.05 (DW)	0.05 (DW)

* at or about the LOQ.

dw – dry weight

Commodity	STMR or STMR-P, mg/kg	HR or HR-P, mg/kg
Name		
Barley forage	0.05 (as)	0.073 (as)

as- as received basis

DIETARY RISK ASSESSMENT

Long-term dietary exposure

The International Estimated Daily Intakes (IEDIs) of imazamox were calculated for the 17 GEMS/Food cluster diets using STMRs/STMR-Ps estimated by the 2014 JMPR and the current Meeting (Annex 3). The ADI is 0–3 mg/kg bw and the calculated IEDIs were 0% of the maximum ADI (3 mg/kg bw). The Meeting concluded that the long-term dietary exposure to residues of imazamox, resulting from uses considered by the JMPR, is unlikely to present a public health concern.

Short-term dietary exposure

The International Estimated Short-Term Intakes (IESTI) for imazamox were calculated for food commodities and their processed commodities using HRs/HR-Ps or STMRs/STMR-Ps estimated by the current Meeting (Annex 4). The ARfD is 3 mg/kg bw and the calculated IESTIs were a maximum of 0% of the ARfD. The Meeting concluded that the short-term dietary exposure to residues of imazamox, when used in ways that have been considered by the current JMPR, is unlikely to present a public health concern.

REFERENCES

Code	Author	Year	Title, Institution, Report reference
2009/1130682	Allen K.	2009	Determination of residues of Imazamox and Imazapyr in imidazolinone tolerant barley following a single foliar application of Intervix at first node detectable crop stage Peracto Pty Ltd., Devonport Tasmania 7310, Australia 2009/1130682, GLP, Unpublished
2016/8000282	Bower M.	2016	Determination of residues of Imazamox, (metabolite CL263284/4110773) and Imazapyr in Clearfield (Scope) barley Peracto Pty Ltd., Devonport Tasmania 7310, Australia 2016/8000282, GLP, Unpublished