Analytical method for lambda-cyhalothrin in water

Reports:	ECM: EPA MRID No.: 49721702 (Appendix 1, pp. 41-82). Mayer, L.C. 2015. Lambda-cyhalothrin: Residue Method (GRM043.09A) for the Determination of Lambda-cyhalothrin in Water – Analytical Method. Report No.: GRM043.09A. Task No.: TK0278097. Report prepared, sponsored and submitted by Syngenta Crop Protection, LLC, Greensboro, North Carolina; 42 pages. Final report issued July 2015 (day not reported). ILV: EPA MRID No. 49721702. Guo, D. 2015. Lambda-cyhalothrin: Lambda-cyhalothrin – Independent Laboratory Validation of Residue Method (GRM043.09A) for the Determination of Lambda-cyhalothrin in Water – Final ILV Report. Report No: PASC-REP-0657. PASC Project No.: 141-1188. Task No.: TK0268649. Report prepared by Primera Analytical Solutions Corp., Princeton, New Jersey; sponsored and submitted by Syngenta Crop Protection, LLC, Greensboro, North Carolina; 91 pages. Final report issued August 17, 2015.
Document No.:	MRID 49721702
Guideline:	850.6100
Statements:	ECM: The study was conducted with no claim of compliance with USEPA Good Laboratory Practice (GLP) standards (Appendix 1, p. 43 of MRID 49721702). No Data Confidentiality and GLP statements were provided, but not signed and dated (Appendix 1, pp. 42-43). Quality Assurance and Authenticity statements were not provided. A signed and dated Summary of Revisions to the original method (ZENECA Analytical Residue Method TMR0940B) was provided (Appendix 1, p. 44; see Reviewer's Comment #1). ILV: The study was conducted in compliance with USEPA GLP standards (p. 3 of MRID 49721702). Signed and dated No Data Confidentiality, GLP, and Quality Assurance statements were provided (pp. 2-4). A statement of the authenticity was not provided.
Classification:	This analytical method is classified as **Acceptable**. The determinations of the LOQ and LOD were not based on scientifically acceptable procedures. In the ECM, the number of samples (n = 4) was insufficient at the LOQ and 10×LOQ.
PC Code:	128897
Reviewer:	Lewis Ross Brown, III Environmental Biologist

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Signature:

Date: Mar 3, 2016

Page numbers for MRID 49721702 refer to those listed in the bottom-most right-handed corner of the pages.

Executive Summary

This analytical method, Syngenta Residue Method (GRM043.09A), is designed for the quantitative determination of lambda-cyhalothrin in water at the stated LOQ of 10 ng/L (10 ppt) using GC/MS. Lambda-cyhalothrin was identified and quantified using one ion transition (*m/z* 241). Two confirmatory ions (*m/z* 243 and *m/z* 205) were monitored, but the recoveries were not quantified.

The LOQ (10 ng/L) is greater than the lowest toxicological level of concern in water (2 ng/L). The ECM was performed using surface water; however, the number of samples (n = 4) was insufficient at the LOQ and 10×LOQ. The method was validated by the ILV at both fortification levels after one trial with no modifications using surface water. The surface water matrix of the ILV and ECM appeared to be the same, based on the provided source and characterization data.

Table 1. Analytical Method Summary

Analyte(s) by Pesticide	MRID		EPA Review	Matrix	Method Date (dd/mm/yyyy)	Registrant	Analysis	Limit of Quantitation (LOQ)
	Environmental Chemistry Method	Independent Laboratory Validation						
Lambda-cyhalothrin	49721702	49721702		Water[1,2]	??/07/2015[3]	Syngenta	GC/MS	10 ng/L (10 ppt)

1 In the ECM, the surface water matrix was collected from Julian, North Carolina, and well characterized (pH 8.6, $CaCO_3$ 21 mg/L, TDS 84 ppm; Appendix 1, Table 1, p. 63 of MRID 49721702).
2 In the ILV, the surface water matrix was provided by the sponsor and well characterized (pH 8.6, $CaCO_3$ 21 mg/L, TDS 84 ppm; p. 10; Table 1, p. 16 of MRID 49721702). This matrix seemed to be the same as the matrix of the ECM.
3 The day of the report date was not specified on the cover page or any signature page of the ECM. ILV dated August 17, 2015.

I. Principle of the Method

Samples (100 mL) of water were fortified, as necessary, in a 125-mL polypropylene bottle (Nalgene) and extracted with 5 mL of hexanes (equivalent to 5% of sample volume) via shaking for 2 hours using a mechanical shaker (shaking setting not specified; Appendix 1, pp. 52-53; Appendix 1, Appendix 1, p. 80; Appendix 1, Appendix 3, p. 82 of MRID 49721702). After centrifugation for 30 minutes at 3500 rpm, the upper layer was transferred to a clean 15-mL polypropylene centrifuge tube. An aliquot (1 mL) of the sample was transferred to an auto-sampler vial and analyzed by GC/MS.

The ECM study author noted the following precautions for performing the extraction procedure: 1) for low level residue analysis, the use of sample container rinses and disposable labware was recommended to increase procedural recoveries and avoid cross-contamination; and 2) a pH of 6 should be maintained since epimerization of lambda-cyhalothrin was observed at high pH (Appendix 1, p. 53 of MRID 49721702).

Samples were analyzed for lambda-cyhalothrin using a Hewlett Packard 6890 GC using a Hewlett Packard 5973 detector in negative ion chemical ionization mode (NICI; Appendix 1, pp. 53-55; Appendix 1, Appendix 1, p. 80 of MRID 49721702). The GC/MS conditions were as follows: HP-5MS column (30.0 m x 0.25 mm, 0.25 µm); helium carrier gas (1.0 mL/min.); injector temperature 275°C; oven temperature gradient, 1 min. 150°C to 1.5 min. 300°C at 20°C/min.; injection volume 4 µL; and mass spectrometer in chemical (SIM) mode with negative polarity. Lambda-cyhalothrin was identified and quantified using three ions (primary, confirmatory 1 and confirmatory 2): *m/z* 241, *m/z* 205 and *m/z* 243, respectively. The retention time for lambda-cyhalothrin was *ca*. 9.2 minutes. No further confirmation technique was employed. The study author noted that lambda-cyhalothrin may epimerize to form its diastereoisomer R157836 under high-temperature GC/MS

operating conditions. If this occurs, the recoveries of both diastereomers should summed for total lambda-cyhalothrin residue after the identity of R157836 has been confirmed.

The ILV was performed exactly as above using the same analytical instruments (pp. 10-11; Appendix 1, pp. 41-82 of MRID 49721702). Lambda-cyhalothrin was identified and quantified using same three ions (primary, confirmatory 1 and confirmatory 2) as the ECM. The retention time for lambda-cyhalothrin was *ca*. 8.9 minutes (Figures 9-12, pp. 28-29). No modifications to the ECM were required.

In the ECM and ILV, the LOQ and LOD for lambda-cyhalothrin were 10 ng/L (10 ppt) and 0.05 pg/µL (equivalent to 0.2 pg injected on the column), respectively (p. 11; Appendix 1, p. 58 of MRID 49721702).

II. Recovery Findings

ECM (MRID 49721702; Appendix 1, pp. 41-82): Mean recoveries and relative standard deviations (RSDs) were within guideline requirements (mean 70-120%; RSD ≤20%) for analysis of lambda-cyhalothrin in water at the fortification level of 10 ng/L (10 ppt; LOQ) and 100 ng/L (100 ppt; 10×LOQ; uncorrected recovery results; Appendix 1, Table 2, p. 63; DER Attachment 2). The number of samples (n = 4) was insufficient at the LOQ and 10×LOQ. Lambda-cyhalothrin was identified and quantified using one ion transition (*m/z* 241). Two confirmatory ions (*m/z* 243 and *m/z* 205) were monitored, but the recoveries were not quantified (Appendix 1, p. 55; Appendix 1, Figures 11-12, pp. 76-77). The reviewer-calculated RSD values did not agree with those presented by the study author and corresponded with the recovery data more than those presented by the study author (Appendix 1, Table 2, p. 63; DER Attachment 2). The surface water matrix was collected from Julian, North Carolina, and well characterized (pH 8.6, $CaCO_3$ 21 mg/L, TDS 84 ppm; Appendix 1, Table 1, p. 63).

ILV (MRID 49721702): Mean recoveries and relative standard deviations (RSDs) were within guideline requirements for analysis of lambda-cyhalothrin in water at fortification levels of 10 ng/L (10 ppt; LOQ) and 100 ng/L (100 ppt; 10×LOQ; uncorrected recovery results; p. 13; Table 3, p. 18). Lambda-cyhalothrin was identified and quantified using one ion transition (*m/z* 241). Two confirmatory ions (*m/z* 243 and *m/z* 205) were monitored, but the recoveries were not quantified (Figures 9-10, pp. 28-29). The method was validated for lambda-cyhalothrin at both fortification levels after one trial with no modifications (p. 8). The surface water matrix (RIMV00115-0001; CAPY081512) was provided by the sponsor and well characterized by Agvise Laboratories, Northwood, North Dakota (pH 8.6, $CaCO_3$ 21 mg/L, TDS 84 ppm; p. 10; Table 1, p. 16 of MRID 49721702). This water matrix appeared to match the water matrix of the ECM.

Table 2. Initial Validation Method Recoveries for Lambda-cyhalothrin in Water[1,2]

Analyte	Fortification Level (ng/L)	Number of Tests	Recovery Range (%)	Mean Recovery (%)	Standard Deviation (%)	Relative Standard Deviation (%)
Surface Water						
Primary ion (*m/z* 241)						
Lambda-cyhalothrin	10 (LOQ)	4	86-103	94	7	12 (8)[3]
	100	4	68-103	87	16	14 (19)[3]

Data (uncorrected recovery results; Appendix 1, pp. 55-56) were obtained from Appendix 1, Table 2, p. 63 of MRID 49721702. Standard deviations were reviewer-calculated from the data in the study report since the study author only reported means and RSDs (see DER Attachment 2).

1 The surface water matrix was collected from Julian, North Carolina, and well characterized (pH 8.6, $CaCO_3$ 21 mg/L, TDS 84 ppm; Appendix 1, Table 1, p. 63).

2 Recoveries for the confirmatory ions (*m/z* 243 and *m/z* 205) were not quantified.

3 RSD values in parenthesis were reviewer-calculated (see DER Attachment 2). The reviewer-calculated values did not agree with those presented by the study author and corresponded with the recovery data more than those presented by the study author.

Table 3. Independent Validation Method Recoveries for Lambda-cyhalothrin in Water[1,2]

Analyte	Fortification Level (ng/L)	Number of Tests	Recovery Range (%)	Mean Recovery (%)	Standard Deviation (%)	Relative Standard Deviation (%)
Surface Water						
Primary ion (*m/z* 241)						
Lambda-cyhalothrin	10 (LOQ)	5	75-79	78	2	2
	100	5	72-85	78	5	6

Data (uncorrected recovery results; Appendix 1, pp. 55-56) were obtained from p. 13; Table 3, p. 18 of MRID 49721702.

1 The surface water matrix (RIMV00115-0001; CAPY081512) was provided by the sponsor and well characterized by Agvise Laboratories, Northwood, North Dakota (pH 8.6, $CaCO_3$ 21 mg/L, TDS 84 ppm; p. 10; Table 1, p. 16).

2 Recoveries for the confirmatory ions (*m/z* 243 and *m/z* 205) were not quantified.

III. Method Characteristics

In the ECM and ILV, the LOQ and LOD for lambda-cyhalothrin were 10 ng/L (10 ppt) and 0.05 pg/µL (equivalent to 0.2 pg injected on the column), respectively (p. 11; Appendix 1, p. 58 of MRID 49721702). In the ECM and ILV, the LOQ was defined as the lowest analyte concentration in a sample at which the method has been validated (mean recovery 70-110% or 70-120%, RSD ≤20%). The ECM study author also advised that the response for the analyte peak should be no less than four times the mean amplitude of the background noise at the analyte retention time in the control sample. In the ECM and ILV, the LOD was defined as the lowest analyte concentration which can be detected above the mean amplitude of the background noise at the analyte retention time in the control sample. The ECM and ILV study authors also noted that the LOD can be estimated as three times the background noise and will vary between instruments and analytical runs.

Table 4. Method Characteristics for Lambda-cyhalothrin in Water

		Lambda-cyhalothrin
Limit of Quantitation (LOQ)		10 ng/L (10 ppt)
Limit of Detection (LOD)		0.05 pg/µL (equivalent to 0.2 pg injected on the column)
Linearity (calibration curve r^2 and concentration range)[1]	ECM	r^2 = 0.996 (*m/z* 241) (0.2-200 pg or 0.05–50.0 pg/µL)
	ILV	r^2 = 1.00 (*m/z* 241) (0.2-40 pg or 0.05–10.0 pg/µL)
Repeatable	ECM[2]	Yes at LOQ and 10×LOQ, but n= **4**
	ILV[3]	Yes at LOQ and 10×LOQ
Reproducible		Yes
Specific	ECM	Yes; matrix interferences were <5% of the LOQ at the analyte retention time.
	ILV	Yes; no matrix interferences were observed.

Data were obtained from pp. 10-13; Table 3, p. 18; Figures 7-11, pp. 26-30; Appendix 1, p. 58; Appendix 1, Table 2, p. 63; Appendix 1, Figures 9-13, pp. 74-78 of MRID 49721702.

1 Recoveries were only quantified for the primary ion transition (*m/z* 241). Two confirmatory ions (*m/z* 243 and *m/z* 205) were monitored, but the recoveries were not quantified. A confirmatory method is not required where GC/MS and/or LC/MS methods are used as the primary method(s) to generate study data.

2 In the ECM, the surface water matrix was collected from Julian, North Carolina, and well characterized (pH 8.6, $CaCO_3$ 21 mg/L, TDS 84 ppm; Appendix 1, Table 1, p. 63 of MRID 49721702).

3 In the ILV, the surface water matrix (RIMV00115-0001; CAPY081512) was provided by the sponsor and well characterized (pH 8.6, $CaCO_3$ 21 mg/L, TDS 84 ppm; p. 10; Table 1, p. 16 of MRID 49721702). This matrix seemed to be the same as the matrix of the ECM.

IV. Method Deficiencies and Reviewer's Comments

1. The ECM (Appendix 1, pp. 41-83 of MRID 49721702) was "adapted from ZENECA Analytical Residue Method TMR0940B for the analysis of Lambda-cyhalothrin only" (Appendix 1, p. 44 of MRID 49721702). Other modifications of ZENECA Analytical Residue Method TMR0940B included updated GC/MS conditions, decreased sample size from 500 mL to 100 mL and methanol-based fortification solutions (Appendix 1, p. 49). ZENECA Analytical Residue Method TMR0940B was provided as EPA MRID No.: 49520002 [Westberg, G.L. 2000. Lambda-cyhalothrin: Lambda-cyhalothrin – Validation of a Method to Determine Lambda-cyhalothrin and R157836 in Surface Water Matrix by Gas Chromatography and Determination of its Method Detection Limit – Final Report. Report No.: TMR0940B. Task No.: TK0253125. Zeneca Report No.: TMR0940B (WINo 52108; p. 4). Report prepared by Morse Laboratories, Inc., Sacramento, California; sponsored by Zeneca Ag Products, Inc., Richmond, California (p. 4); and sponsored and submitted by Syngenta Crop Protection, LLC, Greensboro, North Carolina; 42 pages. Final report issued July 21, 2000.]. MRID 49520002 was not reviewed since the ILV MRID 49721702 validated the adapted ECM. No ILV was submitted to validate MRID 49520002.

2. The estimations of the LOQ and LOD in the ECM and ILV were not based on scientifically acceptable procedures as defined in 40 CFR Part 136 (p. 11; Appendix 1, p. 58 of MRID 49721702). In the ECM and ILV, the LOQ was defined as the lowest analyte concentration in a sample at which the method has been validated (mean recovery 70-110% or 70-120%,

RSD ≤20%). The ECM study author also advised that the response for the analyte peak should be no less than four times the mean amplitude of the background noise at the analyte retention time in the control sample. In the ECM and ILV, the LOD was defined as the lowest analyte concentration which can be detected above the mean amplitude of the background noise at the analyte retention time in the control sample. The ECM and ILV study authors also noted that the LOD can be estimated as three times the background noise and will vary between instruments and analytical runs.

Detection limits should not be based on the arbitrarily selected lowest concentration in the spiked samples.

3. The surface water matrix of the ILV and ECM appeared to be the same, based on the provided source and characterization data (p. 10; Table 1, p. 16; Appendix 1, Table 1, p. 63 of MRID 49721702).

4. In the ECM, the number of samples (n = 4) was insufficient at the LOQ and 10×LOQ (Table 2, p. 23 of MRID 49721702). OCSPP Guidelines require that a minimum of five spiked replicates were analyzed at each concentration (*i.e.*, minimally, the LOQ and 10×LOQ) for each analyte.

5. Two typographical errors were noted in the ECM: the appendix for the analytical procedure flow-chart was reported as "**Appendix 4**", instead of "**Appendix 3**" (Appendix 1, pp. 52, 82 of MRID 49721702); and the GC column dimensions were reported as "30.0 m x **0.25 m**, 0.25 µm", instead of "30.0 m x **0.25 mm**, 0.25 µm" in Appendix 1 (Appendix 1, Appendix 1, p. 80).

6. In the ECM, lambda-cyhalothrin was stable in the final extracts in n-hexane when stored at *ca*. 4°C for up to 7 days (Appendix 1, p. 59; Appendix 1, Table 4, p. 64 of MRID 49721702).

7. In the ECM, matrix effects were assessed. No matrix effects were observed in the water matrix tested, and non-matrix matched standards were used (Appendix 1, p. 59; Appendix 1, Table 3, p. 63 of MRID 49721702). However, the study author recommended that matrix-matched standards be used if any matrix effects observed.

8. It was reported in the ECM that one analyst could complete a batch of 13 water samples in 8 hours (one working day; Appendix 1, p. 60 of MRID 49721702). No timeframe for analysis was reported in the ILV.

9. No communications between the independent laboratory and Syngenta study monitors and study director were necessary (p. 13 of MRID 49721702).

V. References

U.S. Environmental Protection Agency. 2012. Ecological Effects Test Guidelines, OCSPP 850.6100, Environmental Chemistry Methods and Associated Independent Laboratory Validation. Office of Chemical Safety and Pollution Prevention, Washington, DC. EPA 712-C-001.

40 CFR Part 136. Appendix B. Definition and Procedure for the Determination of the Method Detection Limit-Revision 1.11, pp. 317-319.

Attachment 1: Chemical Names and Structures

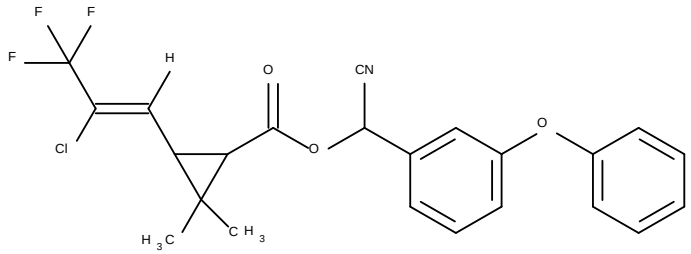
Lambda-cyhalothrin

IUPAC Name: Reaction product comprising equal quantities of (R)-α-cyano-3-phenoxybenzyl (1S,3S)-3-[(Z)-2-chloro-3,3,3-trifluoropropenyl]-2,2-dimethylcyclopropanecarboxylate and (S)-α-cyano-3-phenoxybenzyl (1R,3R)-3-[(Z)-2-chloro-3,3,3-trifluoropropenyl]-2,2-dimethylcyclopropanecarboxylate

CAS Name: (R)-cyano(3-phenoxyphenyl)methyl (1S,3S)-rel-3-[(1Z)-2-chloro-3,3,3-trifluoro-1-propen-1-yl]-2,2-dimethylcyclopropanecarboxylate

CAS Number: 91465-08-6

SMILES String: FC(F)(F)C(Cl)=CC1C(C)(C)C1C(=O)OC(C#N)c2cc(Oc3ccccc3)ccc2



Test Material:	Lambda-cyhalothrin
MRID:	49721702
Title:	Lambda-cyhalothrin: Lambda-cyhalothrin – Independent Laboratory Validation of Residue Method (GRM043.09A) for the Determination of Lambda-cyhalothrin in Water – Final ILV Report
EPA PC Code:	128897
OCSPP Guideline:	850.6100

For CDM Smith

Primary Reviewer: Lisa Muto **Signature:** 

Date: 1/12/16

Secondary Reviewer: Kathleen Ferguson **Signature:**

Date: 1/12/16

QC/QA Manager: Joan Gaidos **Signature:** 

Date: 1/12/16