

Test Material: Tefluthrin
MRID: 49394207
Title: Tefluthrin: Residue Method for the Determination of Tefluthrin in Soil
MRID: 49394202
Title: Tefluthrin - Independent Laboratory Validation of Residue Method (GRM002.04A) for the Determination of Tefluthrin in Soil by GC/MS
EPA PC Code: 128912
OCSP Guideline: 850.6100

For CDM Smith

Primary Reviewer: Lynne Binari

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Date: 4/2/15

Analytical method for tefluthrin in soil

Reports: ECM: EPA MRID No.: 49394207. Hargreaves, S. 2006. Tefluthrin: Residue Method for the Determination of Tefluthrin in Soil (p. 4 of MRID 49394207; p. 8 of MRID 49394202). Report prepared, by Syngenta, Jealott's Hill International Research Centre, Berkshire, United Kingdom, sponsored and submitted by Syngenta Crop Protection, LLC, Greensboro, North Carolina; 33 pages. Syngenta Report No.: GRM002.04A and Task No.: TK0229384. Final report issued October 20, 2006.
ILV: EPA MRID No. 49394202. Arndt, T., and H. Shen. 2014. Tefluthrin - Independent Laboratory Validation of Residue Method (GRM002.04A) for the Determination of Tefluthrin in Soil by GC/MS. Report prepared by PTRL West, Hercules, California, sponsored and submitted by Syngenta Crop Protection, LLC, Greensboro, North Carolina; 83 pages. PTRL Report No.: 2450W. Syngenta Task No.: TK0211351 (pp. 1, 5). Final report issued March 10, 2014.

Document No.: MRIDs 49394207 & 49394202


Guideline: 850.6100

Statements: ECM: The study was not conducted in compliance with OECD Principles of Good Laboratory Practice (GLP) and, therefore, not in accordance with USEPA GLP standards (p. 3 of MRID 49394207). Signed and dated Data Confidentiality and GLP statements were provided (pp. 2-3). Quality Assurance and Authenticity Certification statements were not provided.
ILV: The study was conducted in compliance with USEPA GLP standards (p. 3 of MRID 49394202). Signed and dated Data Confidentiality, GLP, and Quality Assurance statements were provided (pp. 2-4). The certification of the authenticity of the study report is included in the Quality Assurance Statement (p. 4).

Classification: This analytical method is classified as unacceptable but upgradable upon addressing the following issues: The determinations of the LOQ and LOD were not based on scientifically acceptable procedures. The ILV did not report a LOD. The registrant failed to provide the independent laboratory with the most difficult analytical sample condition to analyze to demonstrate how well the method performs.

PC Code: 128912

Reviewer: Ibrahim Abdel-Saheb, Ph.D.
Environmental Scientist
US EPA

Signature: 
Date: 6-29-2016

For both MRIDs, page citations in this review refer to the bottommost set of page numbers located in the bottom right corner of each page of the MRID.

Executive Summary

This analytical method, Syngenta Analytical Method GRM002.04A, is designed for the quantitative determination of tefluthrin in soil using GC/MS. The method is quantitative for the analyte at the stated LOQ of 0.01 mg/kg. The independent laboratory validated the method for analysis of tefluthrin using the target ion m/z 177 in a clay loam soil after one trial. No major modifications were made by the independent laboratory. The clay loam soil (29% clay, 1.9% organic matter) used in the ILV, and supplied by Syngenta, was not of an equivalent, or more difficult, analytical sample condition as the sandy loam (14% clay, 6.6% organic matter) and silty clay (45% clay, 4.5% organic matter) soils used in the ECM validation; therefore, the registrant failed to provide the independent laboratory with the most difficult analytical sample condition to analyze to demonstrate how well the method performs.

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						
Tefluthrin	49394207	49394202		Soil ¹	20/10/2006	Syngenta Crop Protection, LLC	GC/MS	0.01 mg/kg

¹ A clay loam soil (29% clay, 1.9% organic matter) was used in the ILV (Appendix 4, p. 74 of MRID 49394202). Sandy loam (14% clay, 6.6% organic matter) and silty clay (45% clay, 4.5% organic matter) soils were used in the ECM validation (Appendix 3, Table 1, p. 25 of MRID 49394207).

I. Principle of the Method

Soil (20 g) was fortified with tefluthrin in acetonitrile for procedural recoveries (pp. 12, 14 of MRID 49394207). A sandy loam soil and a silt clay soil were used for the validation (Appendix 3, Table 1, p. 25). Soil samples (20 g) are reflux extracted with 100 mL of acetonitrile for 1 hour (p. 14; Appendix 7, p. 33). Following cooling and settling, an aliquot (1 mL) of the extract is taken for direct GC/MS analysis.

Samples are analyzed using an Agilent 5973 MSD equipped with an Agilent 6890 GC system (pp. 15-16; Appendix 6, Figure 9, p. 32 of MRID 49394207). The following GC conditions were used: Agilent HP5MS column (0.25 mm x 30.0 m, $df = 0.25 \mu\text{m}$, injector temperature 275°C), temperature program [100°C (hold for 1 minute), 30°C/min. to 300°C (hold for 1 minute)]. Injection volume was 2 μL . The following MSD conditions were used: electron impact (EI) mode with autotune and selected ion monitoring (SIM). Tefluthrin is identified monitoring three ions; Target ion m/z 177, Qualifier 1 ion m/z 197, and Qualifier 2 ion m/z 199; quantification may be done with any of the three ions. Expected retention time for tefluthrin is *ca.* 6.2 minutes. A confirmatory method was not used (p. 16).

ILV: The test compound and clay loam soil matrix were supplied by Syngenta (pp. 9-10 of MRID 49394202). The independent laboratory performed the extraction method as written (pp. 11-13; Appendix 2, pp. 43-72). The following modification to the GC/MS conditions was made: an Agilent DB-5 column (0.25 mm x 30 m, $df = 0.25 \mu\text{m}$) was used. Approximate retention time was 5.8 minutes for tefluthrin.

LOQ and LOD: In the ECM and ILV, the LOQ for tefluthrin was 0.01 mg/kg (pp. 11, 19 of MRID 49394207; pp. 9, 12 of MRID 49394202). In the ECM, the LOD for tefluthrin was estimated at 0.0003 mg/kg using the target ion m/z 177. In the ILV, the LOD was not specified.

II. Recovery Findings

ECM (MRID 49394207): Mean recoveries and relative standard deviations (RSDs) were within guidelines (mean 70-120%; RSD \leq 20%) for analysis of tefluthrin in a sandy loam soil and a silty clay soil at fortification levels of 0.01 mg/kg (LOQ) and 0.1 mg/kg (10x LOQ; Appendix 3, Tables 1-2, p. 25). Tefluthrin was identified and quantified by monitoring three ions with m/z >100; a confirmatory method was not used (pp. 16, 18). Although not specified, tefluthrin quantitation appears to have been performed using the target ion m/z 177 (p. 19; Appendix 4, Figures 2-6, pp. 26-30). The soil matrices were characterized.

ILV (MRID 49394202): Mean recoveries and relative standard deviations (RSDs) were within guidelines (mean 70-120%; RSD \leq 20%) for analysis of tefluthrin in a clay loam soil at fortification levels of 0.01 mg/kg (LOQ) and 0.1 mg/kg (10x LOQ; Tables 3-5, pp. 21-23). The method was validated for tefluthrin at both fortification levels using the target ion m/z 177 after one trial (p. 14). The soil was characterized by Agvise Laboratories, Northwood, North Dakota (Table 1, p. 19; Appendix 4, p. 74). The soil matrix used in the ILV was supplied by Syngenta and selected because it is representative of the matrix the method was designed for (p. 10). However, the clay loam soil (29% clay, 1.9% organic matter) used in the ILV was not of an equivalent, or more difficult, analytical sample condition as the sandy loam (14% clay, 6.6% organic matter) and silty clay (45% clay, 4.5% organic matter) soils used in the ECM validation.

Table 2. Initial Validation Method Recoveries for Tefluthrin in Soil

Soil ¹	Fortification Level (mg/kg)	Number of Tests	Recovery Range (%)	Mean Recovery (%)	Standard Deviation (%)	Relative Standard Deviation (%)
Sandy Loam	0.01 (LOQ)	5	99-105	102	3	3
	0.1	5	97-102	100	2	2
Silty Clay	0.01 (LOQ)	5	98-101	100	1	1
	0.1	5	94-99	95	2	2

Data (uncorrected recovery results) were obtained from Appendix 3, Table 2, p. 25 of MRID 49394207 and DER Attachment 2 (standard deviations).

¹ USDA classifications (Appendix 3, Table 1, p. 25 of MRID 49394207).

Table 3. Independent Validation Method Recoveries for Tefluthrin in Clay Loam Soil¹

Ion	Fortification Level (mg/kg)	Number of Tests	Recovery Range (%)	Mean Recovery (%)	Standard Deviation (%)	Relative Standard Deviation (%)
Target (m/z 177)	0.01 (LOQ)	5	93-96	94	1	1
	0.1	5	91-98	94	3	3
Qualifier 1 (m/z 197)	0.1	5	94-100	97	2	2
Qualifier 2 (m/z 199)	0.1	5	91-101	95	4	4

Data (uncorrected recovery results) were obtained from Tables 3-5, pp. 21-23; Appendix 6, pp. 79, 81, 83 of MRID 49394202.

¹ USDA classification (Table 1, p. 19; Appendix 4, p. 74 of MRID 49394202).

III. Method Characteristics

In the ECM and ILV, the LOQ for tefluthrin in soil was 0.01 mg/kg (p. 19 of MRID 49394207; p. 12 of MRID 49394202). The ECM defined the LOQ as the lowest analyte concentration at which the methodology has been validated and a mean recovery of 70-110% and RSD of $\leq 20\%$ has been obtained. The ECM defined the LOD as the lowest analyte concentration detectable above the mean amplitude of the background noise in an untreated matrix control sample at the corresponding retention time and an estimate of the LOD can be taken as four times the background noise. For this ECM, the LOD for tefluthrin was estimated at 0.0003 mg/kg using the target ion m/z 177. In the ILV, the LOD was not specified.

Table 4. Method Characteristics for Tefluthrin in Soil

		Tefluthrin
Limit of Quantitation (LOQ)		0.01 mg/kg
Limit of Detection (LOD)		0.0003 mg/kg
Linearity (calibration curve r^2 and concentration range)	ECM: ¹	Target ion (m/z 177) : $r^2 = 1$
	ILV:	Target (m/z 177) and Qualifier (m/z 197, 199) ions: $r^2 = 0.9988-0.9990$
	Range:	Target ion: 1-100 ng/mL (0.001-1.0 μ g/mL, 2-2,000 pg) Qualifier ions: 5-100 ng/mL
Repeatable	ECM:	Yes at LOQ and 10x LOQ.
	ILV:	Yes at LOQ (only target ion quantitated) and 10x LOQ (target and qualifier ions).
Reproducible		Yes.
Specific ²	ECM:	Yes for sandy loam (Black Birches) soil; interferences at the analyte retention time were $<5\%$ of the LOQ (based on peak area). Chromatograms for silty clay soil matrix blank were not provided; results were reported as $<LOQ$.
	ILV:	Yes; no interferences detected at analyte retention time.

Data were obtained from p. 19; Appendix 3, Table 2, p. 25; Appendix 4, Figures 4-5, pp. 28-29; Appendix 5, Figures 7-8, p. 31 of MRID 49394207; p. 12; Tables 3-5, pp. 21-23; Figure 1, p. 26; Figure 5, p. 30; Appendix 6, pp. 77, 80, 82 of MRID 49394202.

Linearity is satisfactory when $r^2 \geq 0.995$.

1 Not specifically stated, the reviewer presumed the standard curve plots were performed using the target ion m/z 177 (p. 19; Appendix 4, Figures 2-3, pp. 26-27; Appendix 5, Figures 7-8, p. 31).

2 A confirmatory method was not used; however, a confirmatory method is typically not required where GC/MS and LC/MS methods are used as the primary method.

IV. Method Deficiencies and Reviewer's Comments

- The determination of the LOQ and LOD were not based on scientifically acceptable procedures as defined in 40 CFR Part 136, Appendix B. The ECM defined the LOQ as the lowest analyte concentration at which the methodology has been validated and a mean recovery of 70-110% and RSD of $\leq 20\%$ has been obtained. The ECM defined the LOD as the lowest analyte concentration detectable above the mean amplitude of the background noise in an untreated matrix control sample at the corresponding retention time and an estimate of the LOD can be taken as four times the background noise. For this ECM, the LOD for tefluthrin was estimated at 0.0003 mg/kg using the target ion m/z 177. In the ILV, the LOD was not specified.

Detection limits should not be based on the arbitrarily selected lowest concentration in the spiked samples. Additionally, the lowest toxicological level of concern in soil was not reported. An LOQ above toxicological levels of concern results in an unacceptable method classification.

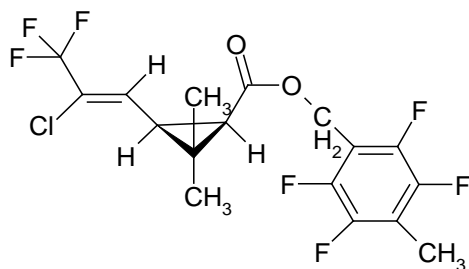
2. The soil matrix used in the ILV was supplied by Syngenta and selected because it is representative of the matrix for which the method was designed (p. 10 of MRID 49394202). However, the clay loam soil (29% clay, 1.9% organic matter) used in the ILV was not of an equivalent, or more difficult, analytical sample condition as the sandy loam (14% clay, 6.6% organic matter) and silty clay (45% clay, 4.5% organic matter) soils used in the ECM validation (Appendix 4, p. 74 of MRID 49394202; Appendix 3, Table 1, p. 25 of MRID 49394207). The registrant failed to provide the independent laboratory with the most difficult analytical sample condition to analyze to demonstrate how well the method performs.
3. Any communication between the independent laboratory and the study sponsor was not reported.
4. For the ILV calibration standards, only chromatograms of 1, 2, and 20 ng/mL non-matrix matched standards and a 2 ng/mL matrix matched standard were provided (calibration standard ranges 1-100 ng/mL for target ion and 5-100 ng/mL for qualifier ions; Figures 2-4, pp. 27-29; Figure 8, p. 33; Appendix 6, pp. 77, 80, 82 of MRID 49394202).
5. For the ECM, reagent blank and chromatograms for the silty clay soil matrix (blank controls and spiked samples at the LOQ and 10x LOQ) were not provided. For the calibration standards, only chromatograms of a 0.05 µg/mL non-matrix matched standard and a 0.02 µg/mL matrix matched standard were provided (calibration standard range 0.001-1.0 µg/mL; p. 19; Appendix 4, Figures 2-3, pp. 26-27 of MRID 49394207). Standard curves with regression curve analyses were provided, but the study author did not specify that these were target ion *m/z* 177 plots (Appendix 5, Figures 7-8, p. 31). The individual calibration standard data for the standard curve plots were not provided.
6. Tefluthrin was identified and quantified by monitoring three ions with *m/z* >100; a confirmatory method was not used (pp. 16, 18 of MRID 49394207). Typically, a confirmatory method is not required where GC/MS and LC/MS methods are used as the primary method(s) to generate study data.
7. The independent laboratory found no significant matrix effects using non-matrix matched and matrix matched 2 ng/mL tefluthrin calibration standards; +6% for the target ion *m/z* 177, ≤±30% for the qualifier ions *m/z* 197 and 199 (p. 15; Table 6, p. 24).
8. The independent laboratory substituted an Agilent DB-5 column (0.25 mm x 30 m, df = 0.25 µm) for the Agilent HP5MS column (0.25 mm x 30 m, df = 0.25 µm) used in the ECM validation (p. 11 of MRID 49394202; p. 15 of MRID 49394207). This modification is not considered a substantial change to the ECM.
9. It was reported for the ILV that a single analyst can complete a set of twelve samples in one working day, with GC/MS analysis performed overnight, followed by two additional hours for data processing and review (p. 15 of MRID 49394202).

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**Tefluthrin (ICI993, ASF611, CGA221149, R151993)**

- IUPAC Name:** 2,3,5,6-Tetrafluoro-4-methylbenzyl (1R,3R)-3-[(Z)-2-chloro-3,3,3-trifluoroprop-1-enyl]-2,2-dimethylcyclopropanecarboxylate.
 2,3,5,6-Tetrafluoro-4-methylbenzyl (1R)-cis-3-[(Z)-2-chloro-3,3,3-trifluoroprop-1-enyl]-2,2-dimethylcyclopropanecarboxylate.
 2,3,5,6-Tetrafluoro-4-methylbenzyl (Z)-(1R)-cis-3-(2-chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylate.
 2,3,5,6-Tetrafluoro-4-methylbenzyl cis-3-(Z-2-chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylate.
- CAS Name:** (2,3,5,6-Tetrafluoro-4-methylphenyl)methyl (1R,3R)-rel-3-[(1Z)-2-chloro-3,3,3-trifluoro-1-propenyl]-2,2-dimethylcyclopropanecarboxylate.
 2,3,5,6-Tetrafluoro-4-methylbenzyl (Z)-(1R)-cis-3-(2-chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylate.
 Cyclopropanecarboxylic acid, 3-(2-chloro-3,3,3-trifluoro-1-propenyl)-2,2-dimethyl-, (2,3,5,6-tetrafluoro-4-methylphenyl) methyl ester, (1- α ,3- α (Z))-(+)-.
- CAS Number:** 79538-32-2
- SMILES String:** Cc2c(F)c(F)c(COC(=O)C1C(C=C(Cl)C(F)(F)F)C1(C)C)c(F)c2F



or

