(1-18-07)

Data Evaluation Report on the phototransformation of tetraconazole on soil

PMRA Submission Number {.....} EPA MRID Number 45851802

Data Requirement: PMRA Data Code:
EPA DP Barcode: D288649
OECD Data Point:
EPA Guideline: 161-3

Test material:
Common name: Tetraconazole.
Chemical name
IUPAC: (RS)-2-(2,4-Dichlorophenyl)-3-(1H-1,2,4-triazol-1-yl)propyl 1,1,2,2-tetrafluoroethyl ether (Reviewer's Comment No. 8).
CAS name: 1-[2-(2,4-Dichlorophenyl)-3-(1,1,2,2-tetrafluoroethoxy)propyl]-1H-1,2,4-triazole.
CAS No: 112281-77-3 (Reviewer's Comment No. 8).
Synonyms: (±)-2-(2,4-Dichlorophenyl)-3-(1H-1,2,4-triazol-1-yl)propyl 1,1,2,2-tetrafluoroethyl ether (Appendix A, p. 142; Reviewer's Comment No. 11).
SMILES string:

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Company Code:
Active Code:
Use Site Category:
EPA PC Code: 120603

CITATION: Scacchi, A. and G. Pizzingrilli. 1996. Aerobic soil degradation of [^{14}C-U-triazole]tetraconazole in three German standard soils under sunlight. Unpublished study performed by Isagro Ricerca, Novara, Italy; sponsored by Isagro S.p.A., Segrate, Italy; submitted by Sipcam Agro USA, Inc., Roswell, Georgia. Document No.: R/ABT.95.03. Experiment initiation April 4, 1995, and completion November 22, 1995 (p. 12). Final report issued April 22, 1996.

EXECUTIVE SUMMARY

The dissipation of [triazole-U-^{14}C]-labeled (±)-2-(2,4-dichlorophenyl)-3-(1H-1,2,4-triazol-1-yl)propyl 1,1,2,2-tetrafluoroethyl ether (tetraconazole) was studied in sand (Speyer 2.1; pH 5.9, organic carbon 0.62%), loamy sand (Speyer 2.2; pH 5.6, organic carbon 2.32%) and sandy loam (Speyer 2.3; pH 6.4, organic carbon 1.22%) soils from Germany for 200 days. [^{14}C]Tetraconazole was applied at an application rate of 6.0 mg a.i./kg soil (dry wt.), equivalent to 1.33 kg a.i./ha. The samples were incubated outdoors where they were exposed to sunlight in Novara, Italy (8.67°E, 45.52°N) between April and October, 1995 and variable temperatures (0-46°C); the soil moisture content was maintained at field capacity. This experiment was submitted under USEPA Subdivision N Guidelines §161-3 and 162-1, but the guidance used to design the study was not reported. It was conducted in compliance with Italian Principles of GLP (1992). The test system consisted of open glass trays containing an approximately 4-mm thick layer of treated soil; volatiles were not trapped. No dark controls were used. Duplicate samples were collected at 0, 15, 30, 60, 100, 150 and 200 days posttreatment, which was equivalent to 0, 45, 152, 288, 617, 977, and 1,162 hours of sunlight (intensity not reported). The soils were extracted sequentially by shaking with acetone, methanol:water (1:1, :v:v) and methanol:0.1N HCl (1:1, v:v). The soil extracts and extracted soils were analyzed for total radioactivity using LSC. The soil extracts were analyzed for tetraconazole by one-dimensional normal-phase TLC; compounds were identified by comparison to unlabeled reference standards that were cochromatographed with the samples. A second method was not used to confirm the identifications.

Overall recoveries averaged 93.32 ± 6.8% (range 79.93-99.39%) of the applied in the Speyer 2.1 sand soil, 94.82 ± 5.1% (range 85.02-100.50%) in the Speyer 2.2 loamy sand soil, and 92.52 ± 6.0% (range 80.82-98.36%) in the Speyer 2.3 sandy loam soil. The material balances were >96% of the applied through 60 days posttreatment, approximately 90% at 100 and 150 days, and 80-86% at 200 days.

In the Speyer 2.1 sand soil, [^{14}C]tetraconazole decreased from an average 98.14% of the applied at 0 days to 59.84% at 30 days posttreatment, 22.44% at 100 days and 11.17% at 200 days (study termination). Two major transformation products were identified. M14360 alcohol averaged a maximum 14.44% of the applied at 60 days posttreatment and decreased to 9.33% at 200 days. Triazolyl acetic acid (TAA) averaged a maximum 10.77% of the applied at 150 days posttreatment and decreased to 9.97% at 200 days. The three minor transformation products that were identified were M14360 acid, triazole and M14360 difluoroacetic acid (DFA), which averaged maximums of 6.36, 6.63, and 3.68% of the applied, respectively, at 100-150 days posttreatment. Unidentified compounds ("others"), which reportedly consisted of up to five compounds, totaled a maximum average of 27.05% of the applied at 100 days. Extractable [^{14}C]residues declined from an average 98.95% at day 0 to 62.98% at 200 days posttreatment; nonextractable [^{14}C]residues increased to 17.19% at 200 days. Volatiles were not collected. There were no dark controls.

In the Speyer 2.2 loamy sand soil, [^{14}C]tetraconazole decreased from an average 97.50% of the applied at 0 days to 81.48% at 30 days posttreatment, 61.60% at 100 days and 49.89% at 200 days. No major transformation products were isolated. Five minor transformation products were identified. M14360 alcohol, M14360 acid, TAA, and triazole averaged maximum of 3.84-5.09% of the applied. M14360 DFA averaged a maximum 2.14% of the applied. Unidentified others (1-5

compounds) totaled a maximum of 7.19% of the applied. Extractable [^{14}C]residues declined from an average of 98.14% at day 0 to 70.42% at 200 days posttreatment; nonextractable [^{14}C]residues increased to 15.89% at 200 days. Volatiles were not collected. There were no dark controls.

In the Speyer 2.3 sandy loam soil, [^{14}C]tetraconazole decreased from an average 97.60% of the applied at 0 days to 53.97% at 30 days posttreatment, 29.63% at 100 days and 17.27% at 200 days. Two major transformation products were identified. M14360 alcohol averaged a maximum 15.50% of the applied at 30 days posttreatment and decreased to 8.95% at 200 days. TAA averaged a maximum 14.11% of the applied at 150 days posttreatment and decreased to 10.81% at 200 days. The three minor transformation products that were identified were M14360 acid, triazole and M14360 DFA at maximum averaged of 7.94, 5.22, and 4.92% of the applied, respectively. Unidentified others (1-5 compounds) totaled a maximum average of 21.08% of the applied. Extractable [^{14}C]residues declined from an average 98.05% at day 0 to 62.37% at 200 days posttreatment; nonextractable [^{14}C]residues increased to 18.86% at 200 days. Volatiles were not collected. There were no dark controls.

Based on first-order linear regression analysis (Excel 2000), tetraconazole dissipated with calculated half-lives of 63.0 days in the Speyer 2.1 sand soil, 203.9 days in the Speyer 2.2 loamy sand soil, and 80.6 days in the Speyer 2.3 sandy loam soils. Since there were no dark controls, the phototransformation half-lives could not be determined.

A transformation pathway was not proposed by the study author.

Results Synopsis

Soil type: Speyer 2.1 Sand soil.
Source of irradiation: Natural sunlight.
Half-life/irradiated (0-200 day data): 63.0 days (r^2 = 0.9655).
Half-life/dark control: Dark controls were not used.
Major transformation products/irradiated:
M14360 alcohol.
Triazolyl acetic acid (TAA).
Minor identified transformation products/irradiated:
M14360 acid.
Triazole.
M14360 difluoroacetic acid (DFA).

Soil type: Speyer 2.2 loamy sand soil.
Source of irradiation: Natural sunlight.
Half-life/irradiated (0-200 day data): 203.9 days (r^2 = 0.9591).
Half-life/dark control: Dark controls were not used.
Major transformation products/irradiated:
None.
Minor identified transformation products/irradiated:
M14360 alcohol.
M14360 acid.
TAA.
Triazole.
M14360 DFA.

Soil type: Speyer 2.3 Sandy loam soil.
Source of irradiation: Natural sunlight.
Half-life/irradiated (0-200 day data): 80.6 days (r^2 = 0.9385).
Half-life/dark control: Dark controls were not used.
Major transformation products/irradiated:
M14360 alcohol.
TAA.
Minor identified transformation products/irradiated:
M14360 acid.
Triazole.
M14360 difluoroacetic acid (DFA).

Study Acceptability: This study, conducted with [triazole-U-^{14}C]tetraconazole, is classified supplemental. The study is scientifically valid, but cannot be used to satisfy the requirement for a photodegradation on soil study because there were no dark controls. Also, temperatures were not constant, it is not certain if all transformation products ≥10% were identified, and the material balances declined to <90% at study termination.

The study cannot be used to satisfy the requirement for an aerobic soil metabolism study because the samples were held outdoors, where they were subject to sunlight and variable temperatures. Also, it is not certain if all transformation products ≥10% were identified, and the material balances declined to <90% at study termination.

I. MATERIALS AND METHODS

GUIDELINE FOLLOWED: This study was submitted by the registrant under USEPA Pesticide Assessment Guidelines, Subdivision N §161-3 and 162-1 (p. 1). Neither the study report nor the protocol identify the guidance that was used to design the study. Significant deviations from Subdivision N Guideline §161-3 were:

There were no dark controls. This does not affect the validity of the study.

The temperature of the samples was allowed to vary, and ranged from 0-46°C. This does not affect the validity of the study.

All transformation products present at >10% of the applied may not have been identified. "Others", which contained up to 25.21% of the applied, was reported to consist of up to five compounds; however, the maximum concentration for any single compound was not reported. This does not affect the validity of the study.

The material balances declined to <90% at 200 days posttreatment in all three soils. There was no attempt to measure or control volatilization. This does not affect the validity of the study.

COMPLIANCE: This study was conducted in compliance with Italian Principles of Good Laboratory Practices (1992; p. 3). Signed and dated GLP, Data Confidentiality, Quality Assurance, and Certificate of Authenticity statements were provided (pp. 2-3, 8-9).

A. MATERIALS:

1. Test Material: [Triazole-U-^{14}C]tetraconazole (p. 14).

Chemical Structure: See DER Attachment 2.

Description: Viscous liquid (p. 14).

Purity: Radiochemical purity: 99.57%.
Lot No.: 144.
Analytical purity: Not reported.
Specific activity: 136.63 µCi/mg (303,313 dpm/µg, 5.06 Mbq/mg).
Location of radiolabel: Uniformly in the triazole ring.

Storage conditions of test chemicals: At -20°C prior to use (p. 15).

Physico-chemical properties of tetraconazole:

Parameter	Values	Comments
Molecular formula	372.16 g/mol	
Molecular weight	$C_{13}H_{11}Cl_2F_4N_3O$	
Water solubility	150 mg/L	At 20°C.
Vapor pressure/volatility	1.32×10^{-4} Pa	At 20°C.
UV absorption	Not reported.	
pKa	Not reported.	
Kow (log Pow)	Not reported.	
Stability of compound at room temperature	Not reported.	

Data obtained from p. 14 of the study report.

2. Soil Characteristics:

Table 1: Field information and handling procedures.

Description	Speyer 2.1	Speyer 2.2	Speyer 2.3
Geographic location:	All three soils were supplied by the Agricultural Research Institute, Speyer, Germany. They were reported to have been collected from their respective natural locations, which were not identified.		
Pesticide use history at the collection site:	Not reported.		
Collection procedures:	Not reported.		
Sampling depth:	0- to 20-cm depth.		
Storage conditions:	At 4°C.		
Storage length:	Not reported.		
Preparation:	2-mm sieved.		

Data obtained from p. 15 of the study report.

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Table 2: Properties of the soil.

Property	Speyer 2.1	Speyer 2.2	Speyer 2.3
Soil texture[1]:	Slightly humus sand.	Very humus loamy sand.	Slightly humus sandy loam.
% sand (2000-63 µm):	88.4	81.2	60.9
% silt (63-2 µm):	9.8	13.4[2]	29.6
% clay (<2 µm):	1.9	5.5	9.5
pH in 0.01M $CaCl_2$:	5.9	5.6	6.4
Organic carbon (%)[2]:	0.62	2.32	1.22
CEC (meq/100 g soil):	5	10.9	1.2
Maximum water capacity (g/100 g soil):	31	48	39
Bulk density, disturbed (g/cm^3):	Not reported.		
Soil Taxonomic classification:	Not reported.		
Soil Mapping Unit:	Not reported.		

Data obtained from p. 15 and Tables 1-3, pp. 32-34 of the study report.
1 The particle size distribution was not in accordance with the USDA Textural Classification System which uses 50 µm as the lower limit of sand, and the registrant did not classify the soils according to the USDA system. Because of the particle size distribution differences, the soils could not be confidently reclassified according to the USDA system by the reviewer.
2 In several instances, the data presented in Tables 1-3 does not correspond to the original lab sheets presented in Appendix E (pp. 164, 165). In Appendix E, for Speyer 2.2, the silt content of the soil sums to 13.4%, not 3.4%. Also, the soil organic content for all soils is reported to be in terms of organic carbon, not organic matter as presented in the Tables.

3. Details of light source:

Table 3: Artificial light source.*

Property	Details
Type of lamp used	Not applicable.
Emission wavelength spectrum	Not applicable.
Light intensity	Not applicable.
Filters used	Not applicable.
Relationship to natural sunlight	Not applicable.

* The soil samples were incubated outdoors and exposed to natural sunlight. The study authors did provide weather conditions and hours of sunlight per day, but did not quantify the intensity of the sunlight.

B. EXPERIMENTAL DESIGN

1. Preliminary Study: A preliminary study was not described.

2. Experimental Design

Table 4: Experimental design.

Parameter		Details
Duration of the test		200 Days.
Condition of soil:	Air dried/fresh:	Fresh.
	Sterile/Non-sterile:	Non-sterile.
Test concentrations (mg a.i./kg soil)		80 µg/10 g soil; 6.0 mg a.i./kg; 133.34 g a.i./ha.
Dark controls used (Yes/No): Method to maintain darkness:		No. Dark controls were not used.
Replications	Dark control:	Dark controls were not used.
	Irradiated:	Duplicate.
Identity and concentration of co-solvent:		Acetonitrile, approximately 2.5% by volume.
Pesticide application	Volume of test solution used/treatment	0.75 mL test solution/10 g soil.
	Method of application	Not reported.
	Is the co-solvent evaporated?	Not reported.
Test apparatus: Type/Material/Volume		Glass trays (bottom area 45 cm^2) containing treated soil (10 g air dry equivalent, *ca.* 4 mm thickness) were placed outdoors in sunlight. Samples were taken into the laboratory on rainy days.
Details of traps for volatiles, if any		There was no volatile trapping.
If no traps were used, is the system closed/open		Open.
Any indication of the test material adsorbing to the walls of the test apparatus?		None.
Experimental Conditions	Temperature:	Day: 11-47°C. Night: 0-24°C.
	Temperature maintenance method:	None.
	Moisture content: Moisture maintenance method	Field capacity. Samples were weighed 1-3 times/day and adjusted if needed.
	Duration of light/darkness:	The samples were irradiated under natural sunlight. The number of hours of sunlight per day ranged from 0 to 10.

Parameter	Details
Other details, if any	None.

Data obtained from pp. 10, 15, 17, 19, 23, Appendix C, pp. 153-160 of the study report.
1 Based on 0.75 mL of the test solution, of which 33% was acetonitrile, applied to 10 g of soil.

3. Supplementary experiments: No supplementary experiments were described.

4. Sampling:

Table 5: Sampling details.

Criteria		Details
Sampling intervals	Irradiated	0, 15, 30, 60, 100, 150 and 200 days (Reviewer-calculated equivalent to 0, 45, 152, 288, 617, 977, and 1,161 hours of sunlight).
	Dark	Dark controls were not used.
Sampling method		Duplicate vessels were collected at each interval.
Method of sampling CO_2 and volatile organic compounds		Volatiles were not trapped.
Sampling intervals/times for: Sterility check, if any Moisture content:		 Sterile controls were not used. Checked 1-3 times per day.
Sample storage before analysis		Not reported.
Other observations, if any		None.

Data obtained from p. 19 of the study report.

C. ANALYTICAL METHODS

Extraction/clean up/concentration methods: Soil samples were sequentially extracted with acetone, methanol:water (1:1, v:v) and methanol:0.1N HCl (1:1, v:v) by shaking for 60 minutes/extraction (50 mL volumes; pp. 19, 20; Figure 1, p. 49). After each extraction, the samples were centrifuged and the supernatant removed; duplicate aliquots of each extract were analyzed for total radioactivity by LSC. Aliquots (10 mL) of each extract were combined, then concentrated to 2 mL using rotary evaporation under vacuum. Aliquots of the concentrated extracts were analyzed using LSC and TLC.

Nonextractable residue determination: The extracted soil was air-dried and analyzed for total radioactivity by LSC following combustion (p. 20).

Volatile residue determination: Volatiles were not collected.

Total ^{14}C measurement: Total ^{14}C residues were determined by summing the concentrations of residues measured in the soil extracts and extracted soil (p. 23).

Derivatization method: A derivatization method was not employed.

Identification and quantification of tetraconazole: Aliquots of the soil extracts (10 µL) were analyzed using one-dimensional TLC on silica gel plates (Merck Kieselgel 60, F254 developed with chlorofrom:methanol (70:30, v:v; Solvent System 2) and chloroform:methanol:water (55:40:5, v:v:v; Solvent System 3, p. 22). Following development, areas of radioactivity were detected and quantified a TLC-Radioscanner. [^{14}C]Tetraconazole was identified by comparison to the location of a tetraconazole reference standard.

Identification and quantification of transformation products: Transformation products were isolated and quantified by TLC as described. Samples were cochromatographed with reference standards of M14360-alcohol, M-14360-acid, M14360-difluoroacetic acid (M14360-DFA), triazole, and triazolyl acetic acid (TAA; p. 22). An examination of the radiochromatograms indicates that M14360-DFA and M14360-acid coelute in Solvent System 2 and triazole and M14360-DFA coelute in Solvent System 3. The concentration of M14360-DFA acid was determined by subtracting the amount of M14360-acid as determined in SS3 from value of the peak represented by M14360-acid plus M14360-DFA in SS2 (footnote, Tables 14-16, pp. 45-47).

Detection limits (LOD, LOQ) for the parent compound: The Limit of Detection (LOD) for LSC analyses were determined as 0.015% (29-55 dpm) of the applied for soil extracts and 0.038% (72-198 dpm) for nonextractable [^{14}C]residues (p. 22). The LOD and LOQs for the TLC analysis were not reported.

Detection limits (LOD, LOQ) for the transformation products: The Limits of Detection and Quantitation were same as for the parent compound.

II. RESULTS AND DISCUSSION:

A. TEST CONDITIONS: During the study period, irradiated samples were maintained outdoors at temperatures ranging from 0 to 47°C (Appendix C, pp. 153-160). Soil moisture was maintained at field capacity; no supporting data were provided (p. 10).

B. MASS BALANCE: Overall recoveries averaged 93.32 ± 6.8% (range 79.93-99.39%) of the applied in the Speyer 2.1 sand, 94.82 ± 5.1% (range 85.02-100.50%) in the Speyer 2.2 loamy sand, and 92.52 ± 6.0% (range 80.82-98.36%) in the Speyer 2.3 sandy loam (Tables 4-6, pp. 35-37; Attachment 1; Reviewer's Comment No. 2). The material balances declined during the duration of the study.

Table 6b: Phototransformation of [triazole-U-^{14}C]tetraconazole, expressed as percentage of applied radioactivity (mean ± s.d, n = 2.), on Speyer 2.2 loamy sand soil.*

Compound		Sampling times (Days)						
		0	15	30	60	100	150	200
Tetraconazole	Irradiated	97.50 ± 1.59	90.05 ± 0.90	81.48 ± 2.06	76.85 ± 0.93	61.60 ± 3.35	53.82 ± 2.11	49.89 ± 1.10
M14360 alcohol	Irradiated	ND	0.93 ± 0.20	1.66 ± 0.25	3.39 ± 0.47	3.91 ± 0.52	2.68 ± 0.42	4.81 ± 1.29
M14360 acid	Irradiated	ND	1.56 ± 0.06	1.12 ± 0.14	2.31 ± 0.23	2.33 ± 0.72	5.09 ± 0.48	4.86 ± 0.36
TAA	Irradiated	ND	0.96 ± 0.16	1.06 ± 0.40	1.71 ± 0.20	3.56 ± 0.32	3.84 ± 1.22	3.04 ± 0.40
Triazole	Irradiated	ND	1.05 ± 0.02	1.24 ± 0.54	3.30 ± 0.28	4.88 ± 1.14	2.09 ± 0.24	1.60 ± 0.01
M14360 DFA[1]	Irradiated	ND	0.00 ± 0.00	0.31 ± 0.13	0.93 ± 0.64	1.48 ± 1.26	2.14 ± 0.73	0.15 ± 0.22
Others	Irradiated	0.64 ± 0.17	2.36 ± 0.17	5.18 ± 0.58	5.36 ± 1.00	6.73 ± 0.66	7.19 ± 0.71	6.07 ± 0.90
Total extractable residues	Irradiated	98.14 ± 1.77	96.91 ± 1.14	92.05 ± 1.58	93.85 ± 0.88	84.49 ± 0.24	76.85 ± 0.58	70.42 ± 0.93
Nonextractable residues	Irradiated	0.19 ± 0.01	2.01 ± 0.01	6.39 ± 0.03	5.33 ± 0.98	7.52 ± 2.23	13.69 ± 0.52	15.89 ± 0.91
CO_2 and other volatiles	Irradiated	Volatiles were not trapped						
Total % recovery	Irradiated	98.33 ± 1.76	98.93 ± 1.13	98.44 ± 1.55	99.18 ± 1.86	92.01 ± 2.47	90.54 ± 0.06	86.32 ± 1.84
	Dark	There were no dark controls.						

* Data obtained from Table 5, p. 36, Table 11, p. 42, Table 15, p. 46 of the study report. The study did not include dark controls.
1 M14360-DFA concentrations were determined by study author by subtracting the amount of M14360 acid detected using SS3 from the amount of M14360 acid plus M14360 DFA detected using SS2.
ND = Not detected.

Table 6a: Phototransformation of [triazole-U-^{14}C]tetraconazole, expressed as percentage of applied radioactivity (mean ± s.d., n = 2), on Speyer 2.1 sand soil.*

Compound		Sampling times (Days)						
		0	15	30	60	100	150	200
Tetraconazole	Irradiated	98.14 ± 1.08	81.38 ± 1.08	59.84 ± 0.32	42.27 ± 4.11	22.44 ± 1.92	17.15 ± 0.40	11.17 ± 2.10
M14360 alcohol	Irradiated	ND	2.76 ± 0.66	6.09 ± 0.08	14.44 ± 0.32	11.98 ± 0.32	12.38 ± 0.89	9.33 ± 1.39
M14360 acid	Irradiated	ND	1.03 ± 0.10	2.01 ± 0.25	2.87 ± 0.54	3.50 ± 0.99	6.36 ± 0.05	5.57 ± 0.03
TAA	Irradiated	ND	1.84 ± 0.18	1.79 ± 0.16	3.16 ± 1.40	6.25 ± 0.32	10.77 ± 0.17	9.97 ± 0.92
Triazole	Irradiated	ND	1.17 ± 0.01	3.20 ± 0.06	4.96 ± 1.15	6.63 ± 0.36	3.17 ± 0.17	3.42 ± 0.44
M14360 DFA[1]	Irradiated	ND	1.26 ± 0.81	2.28 ± 1.23	2.42 ± 2.35	3.68 ± 1.53	0.00 ± 0.0	0.47 ± 0.27
Others	Irradiated	0.81 ± 0.58	2.62 ± 1.05	12.48 ± 1.47	16.39 ± 0.16	27.05 ± 4.16	26.75 ± 1.23	23.05 ± 2.09
Total extractable residues	Irradiated	98.95 ± 0.50	92.06 ± 1.10	87.69 ± 0.34	86.51 ± 0.85	81.53 ± 1.99	76.58 ± 1.12	62.98 ± 0.35
Nonextractable residues	Irradiated	0.08 ± 0.00	4.30 ± 0.0	9.67 ± 0.07	10.80 ± 0.16	10.79 ± 0.05	14.09 ± 0.83	17.19 ± 0.01
CO_2 and other volatiles	Irradiated	Volatiles were not trapped						
Total % recovery	Irradiated	99.03 ± 0.50	96.36 ± 1.10	97.36 ± 0.41	97.31 ± 0.70	92.32 ± 1.94	90.68 ± 1.95	80.18 ± 0.35
	Dark	There were no dark controls.						

* Data obtained from Table 4, p. 35, Table 10, p. 41, Table 14, p. 45 of the study report. The study did not include dark controls.
1 M14360-DFA concentrations were determined by study author by subtracting the amount of M14360 acid detected using SS3 from the amount of M14360 acid plus M14360 DFA detected using SS2.
ND = Not detected.

Table 6c: Phototransformation of [triazole-U-^{14}C]tetraconazole, expressed as percentage of applied radioactivity (mean ± s.d, n = 2.), on Speyer 2.3 sandy loam soil.*

Compound		Sampling times (Days)						
		0	15	30	60	100	150	200
Tetraconazole	Irradiated	97.60 ± 0.35	79.72 ± 0.83	53.97 ± 4.38	43.13 ± 2.25	29.63 ± 3.92	20.77 ± 1.78	17.27 ± 1.22
M14360 alcohol	Irradiated	ND	3.03 ± 0.76	15.50 ± 0.73	12.00 ± 2.27	9.38 ± 1.34	6.01 ± 0.62	8.95 ± 0.45
M14360 acid	Irradiated	ND	2.22 ± 0.23	2.92 ± 0.00	7.83 ± 0.44	5.94 ± 0.54	7.94 ± 0.61	5.94 ± 0.11
TAA	Irradiated	ND	1.78 ± 0.46	3.28 ± 0.17	4.99 ± 1.27	3.90 ± 1.51	14.11 ± 0.18	10.81 ± 0.33
Triazole	Irradiated	ND	1.38 ± 0.59	2.91 ± 0.26	4.55 ± 0.47	5.22 ± 0.39	2.02 ± 0.12	2.27 ± 0.27
M14360 DFA[1]	Irradiated	ND	1.05 ± 0.37	1.82 ± 0.50	4.92 ± 2.22	2.82 ± 1.77	0.00 ± 0.00	0.00 ±-0.00
Others	Irradiated	0.45 ± 0.15	3.35 ± 0.63	6.52 ± 3.32	8.84 ± 4.24	19.60 ± 0.78	21.08 ± 5.83	17.13 ± 0.36
Total extractable residues	Irradiated	98.05 ± 0.20	92.53 ± 0.11	86.92 ± 1.19	86.28 ± 1.58	76.49 ± 1.63	71.93 ± 4.35	62.37 ± 1.33
Nonextractable residues	Irradiated	0.15 ± 0.01	5.17± 0.30	10.36 ± 0.45	9.75 ± 0.18	12.15 ± 0.38	16.61 ± 1.05	18.86 ± 1.92
CO_2 and other volatiles	Irradiated	Volatiles were not trapped						
Total % recovery	Irradiated	98.20 ± 0.22	97.70 ± 0.19	97.28 ± 0.74	96.03 ± 1.39	88.64 ± 1.25	88.55 ± 5.40	81.32 ± 0.59
	Dark	There were no dark controls.						

* Data obtained from Table 6, p. 37, Table 12, p. 43, Table 16, p. 47 of the study report. The study did not include dark controls.
1 M14360-DFA concentrations were determined by study author by subtracting the amount of M14360 acid detected using SS3 from the amount of M14360 acid plus M14360 DFA detected using SS2.
ND = Not detected.

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C. TRANSFORMATION OF PARENT COMPOUND: In the German Speyer sand (2.1), [^{14}C]tetraconazole decreased from an average 98.14% of the applied at 0 days to 59.84% at 30 days posttreatment, 22.44% at 100 days, and 11.17% at 200 days (study termination; Table 10, p. 41). In the German Speyer loamy sand (2.2), [^{14}C]tetraconazole decreased from an average 97.50% of the applied at 0 days to 81.48% at 30 days posttreatment, 61.60% at 100 days, and 49.89% at 200 days (Table 11, p. 42). In the German Speyer sandy loam (2.3), [^{14}C]tetraconazole decreased from an average 97.60% of the applied at 0 days to 53.97% at 30 days posttreatment, 29.63% at 100 days, and 17.27% at 200 days (Table 12, p. 43).

Half-lives: Based on first-order linear regression analysis (Excel 2000), tetraconazole dissipated with a calculated half-life of 63.0 days in the Speyer 2.1 sand soil, 203.9 days in the Speyer 2.2 loamy sand soil, and 80.6 days in the Speyer 2.3 sandy loam soil. Since there were no dark controls, photolysis could not be differentiated from biodegradation. These half-lives were longer than the DT50s calculated by the study authors (45, 191 and 43 days, respectively) using Slide Write software, which was not described but appears to be a curve-fitting program (p. 24).

Half-lives*

Test system	First order linear			DT50 (days)	DT90 (days)
	Half-life	Regression equation	r^2		
Speyer 2.1 sand	63.01 days	y = -0.011x + 4.4665	0.9655	45	250
Speyer 2.2 loamy sand	203.87 days	y = -0.0034x + 4.5343	0.9591	191	ND
Speyer 2.3 sandy loam	80.60 days	y = -0.0086x + 4.3918	0.9385	43	311

* Half-lives were calculated by the reviewer using data obtained from Tables 10-12, pp. 41-43 of the study report. DT50 and DT90 values were calculated by the study author (p. 24).
ND - Not determined.

TRANSFORMATION PRODUCTS: In the Speyer 2.1 sand soil, two major transformation products were identified; M14360 alcohol and TAA (Table 14, p. 45). M14360 alcohol averaged a maximum 14.44% of the applied at 60 days posttreatment and averaged 9.33% at 200 days. Triazolyl acetic acid (TAA) averaged a maximum 10.77% of the applied at 150 days posttreatment and averaged 9.97% at 200 days. Three minor transformation products were identified; M14360 acid, triazole and M14360 difluoroacetic acid (DFA). M14360 acid averaged a maximum of 6.36% of the applied at 150 days and was 5.57% at 200 days. Triazole averaged a maximum of 6.63% of the applied at 100 days and was 3.42% at 200 days. M14360 DFA averaged a maximum of 3.68% of the applied at 100 days and was 0.47% at 200 days. Others was comprised of 1-5 compounds (number increased with time) averaged a maximum of 27.05% of the applied at 100 days and was 23.05% at 200 days. Dark controls were not tested.

In the Speyer 2.2 loamy sand soil, no major transformation products were identified (Table 15, p. 46). Five minor transformation products were identified; M14360 alcohol, M14360 acid, TAA, triazole and M14360 DFA. M14360 alcohol averaged a maximum of 3.91% of the applied at 100 days and was 4.81% at 200 days. M14360 acid averaged a maximum of 5.09% of the applied at 150 days and was 4.86% at 200 days. TAA averaged a maximum of 3.84% of the applied at 150 days and was 304% at 200 days. Triazole averaged a maximum of 4.88% of the applied at 100 days

and was 1.60% at 200 days. M14360 DFA averaged a maximum of 2.14% of the applied at 150 days and was 0.15% at 200 days. Others was comprised of 1-5 compounds (number increased with time) averaged a maximum of 7.19% of the applied at 150 days and were 6.07% at 200 days. Dark controls were not tested.

In the Speyer 2.3 sandy loam soil, two major transformation products were identified; M14360 alcohol and TAA (Table 16, p. 47). M14360 alcohol averaged a maximum 15.50% of the applied at 30 days posttreatment and averaged 8.95% at 200 days. TAA averaged a maximum 14.11% of the applied at 150 days posttreatment and averaged 10.81% at 200 days. Three minor transformation products were identified; M14360 acid, triazole and M14360 DFA. M14360 acid averaged a maximum of 7.94% of the applied at 150 days and was 5.94% at 200 days. Triazole averaged a maximum of 5.22% of the applied at 100 days and was 2.27% at 200 days. M14360 DFA averaged a maximum of 4.92% of the applied at 60 days and was 0.00% at 200 days. Others was comprised of 1-5 compounds (number increased with time) averaged a maximum of 21.08% of the applied at 150 days and was 17.13% at 200 days. Dark controls were not tested.

Table 7. Chemical names and CAS numbers for the transformation products of tetraconazole.

Applicant's Code Name	CAS Number	Chemical Name	Chemical formula	Molecular weight (g/mol)	SMILES string
M14360 alcohol		Not provided			
M14360 acid		Not provided			
Triazolyl acetic acid; TAA		Not provided			
Triazole		Not provided			
M14360 difluoroacetic acid (DFA)		Not provided			

Data obtained from Tables 14-16, pp. 45-47 of the study report.

NONEXTRACTABLE AND EXTRACTABLE RESIDUES: In the Speyer 2.1 sand soil, extractable [^{14}C]residues declined from an average 98.95% at day 0 to 62.98% at 200 days posttreatment; nonextractable [^{14}C]residues increased from 0.08% at day 0 to 17.19% at 200 days posttreatment (Table 4, p. 35).

In the Speyer 2.2 loamy sand soil, extractable [^{14}C]residues declined from an average 98.14% at day 0 to 70.42% at 200 days posttreatment; nonextractable [^{14}C]residues increased from 0.19% at day 0 to 15.89% at 200 days posttreatment (Table 5, p. 36).

In the Speyer 2.3 sandy loam soil, extractable [^{14}C]residues declined from an average 98.05% at day 0 to 62.37% at 200 days posttreatment; nonextractable [^{14}C]residues increased from 0.15% at day 0 to 18.86% at 200 days posttreatment (Table 6, p. 37).

VOLATILIZATION: Volatiles were not collected.

TRANSFORMATION PATHWAY: A transformation pathway was not proposed by the study author.

D. SUPPLEMENTARY EXPERIMENT-RESULTS: No supplementary experiments were described.

III. STUDY DEFICIENCIES:

1. There was no dark control. Therefore, the proportion of the degradation due to photolysis rather than biodegradation could not be determined. In the aerobic soil metabolism study submitted in this data package (MRID 45851801), <10% of the applied tetraconazole had degraded in the same three soils after 100 days of incubation (study termination). However, the study conditions were not comparable; in the metabolism study, the samples were held at 20 ± 2°C.

2. The temperature was conducted at ambient outdoor temperatures, which was greater variation than specified under Subdivision N guidelines. The temperature, humidity, cloud conditions, and hours of sunlight per day were reported as required by Subdivision N Guideline §161-3 (1982).

3. Although not stated by the study authors, an examination of the radiochromatograms indicates that M14360-alcohol appears as a shoulder to the tetraconazole peak in both solvent systems. This shoulder is least distinct in the Speyer 2.2 soil. It is not certain that this minimal degree of separation was adequate to adequately distinguish between and quantify tetraconazole and M14360-alcohol.

4. It is not clear if all degradates present at >10% were identified. "Others" comprised maximums of 29.99% and 25.21% of the applied in the Speyer 2.1 sand and Speyer 2.3 sandy loam soils, respectively. The study authors noted that "Others" was comprised of up to five compounds with the number of compounds increasing with time, but did not report the number of compounds at each interval or the maximum concentration of specific unidentified compounds during the study (p. 26, Tables 14-16, pp. 45-47).

5. The material balance declined to 80.18%-86.32% at 200 days posttreatment in the three soils. The study author noted that it was likely that one or more of the degradates was mineralized to CO_2. No attempt was made to collect or control volatiles.

6. Soil moisture was maintained at field capacity, rather than at 75% of 1/3 bar as required by Subdivision N guidelines.

7. The structures and chemical names of the transformation products were not provided. All of the transformation products that were identified were identified by comparison to reference standards. Also, a transformation pathway was not proposed by the study author.

IV. REVIEWER'S COMMENTS

1. The German soils that were used in this study were classified according to BBA soil classification guidelines. The reviewer could not reclassify the soils according to the USDA Soil Textural Classification System because the particle size scale ranges presented in the study differ from those used by the USDA. According to BBA soil classification guidelines, particles in the range of 2.0-0.063 mm are categorized as sand, 0.063-0.002 mm as silt and <0.002 mm as clay.

2. In general, the samples were brought indoors on rainy days. The study author reported that the samples were maintained in the laboratory on the following dates; May 11-14, 16, and 31 (reported to be rainy), June 12 (rainy), August 15 (cloudless), and August 19-20 (variable; Appendix C, pp. 153-160).

3. The study authors did not report how the temperatures were measured. However, since the study was conducted in Italy and the reported maximum temperature in April was as high as 44°C, it is likely that the reported temperatures are for the soil surface rather than the air.

4. It was not stated whether the samples were stored prior to analysis.

5. Detection limits (LOD, LOQ) for the TLC analyses was not specified.

6. The study authors reported that the treatment rate for this study was based on the recommended maximum field application rate for tetraconazole of 125 g a.i./ha (p. 18).

7. It was reported that data from this study were used to confirm the mass balance data recorded in a previous study conducted for 112 days (Report R/ABT.94.10; p. 27). The previous study was not described and a citation was not included in the References, so it was not certain if the study design was similar.

8. (RS)-2-(2,4-Dichlorophenyl)-3-(1H-1,2,4-triazol-1-yl)propyl 1,1,2,2-tetrafluoroethyl ether and 1-[2-(2,4-dichlorophenyl)-3-(1,1,2,2-tetrafluoroethoxy)propyl]-1H-1,2,4-triazole were identified as the IUPAC anc CAS names, respectively, of tetraconazole by the Compendium of Pesticide Common Names (http://www.hclrss.demon.co.uk/tetraconazole.html). CAS Reg. No. 112281-77-3 for tetraconazole was obtained from the USEPA/OPP Chemical Database (http://www.cdpr.ca.gov/cgi-bin/epa/chemidetriris.pl?pccode=120603).

9. In section 12. MATERIALS, 12.1.1 Identification (p. 14), the chemical name for tetraconazole was incorrectly reported as -2-(2,4-dichlorophenyl)-3-(1H-1,2,4-triazol-1-yl)-1-propyl 1,1,2,2-tetrafluoroethyl ether, with the correct chemical name, (±)-2-(2,4-dichlorophenyl)-3-(1H-1,2,4-triazol-1-yl)propyl 1,1,2,2-tetrafluoroethyl ether provided in Appendix A (p. 142).

10. The study authors reported that the results confirmed that data from the field trial (stage 2) in German soils (Study No. NA929822/1) and the degradation pathway reported in an Italian silt loam (Study R/ABT.94.10; p. 28).

V. REFERENCES:

1. U.S. Environmental Protection Agency. 1982. Pesticide Assessment Guidelines, Subdivision N, Chemistry: Environmental Fate, Section 161-3, Photodegradation on Soil studies. Office of Pesticide and Toxic Substances, Washington, DC. EPA 540/9-82-021.

2. U.S. Environmental Protection Agency. 1982. Pesticide Assessment Guidelines, Subdivision N, Chemistry: Environmental Fate, Section 162-1, Aerobic Soil Metabolism studies. Office of Pesticide and Toxic Substances, Washington, DC. EPA 540/9-82-021.

3. U.S. Environmental Protection Agency. 1989. FIFRA Accelerated Reregistration, Phase 3 Technical Guidance. Office of the Prevention, Pesticides, and Toxic Substances, Washington, DC. EPA 540/09-90-078.

4. U.S. Environmental Protection Agency. 1993. Pesticide Registration Rejection Rate Analysis - Environmental Fate. Office of the Prevention, Pesticides, and Toxic Substances, Washington, DC. EPA 738-R-93-010.

Attachment 1

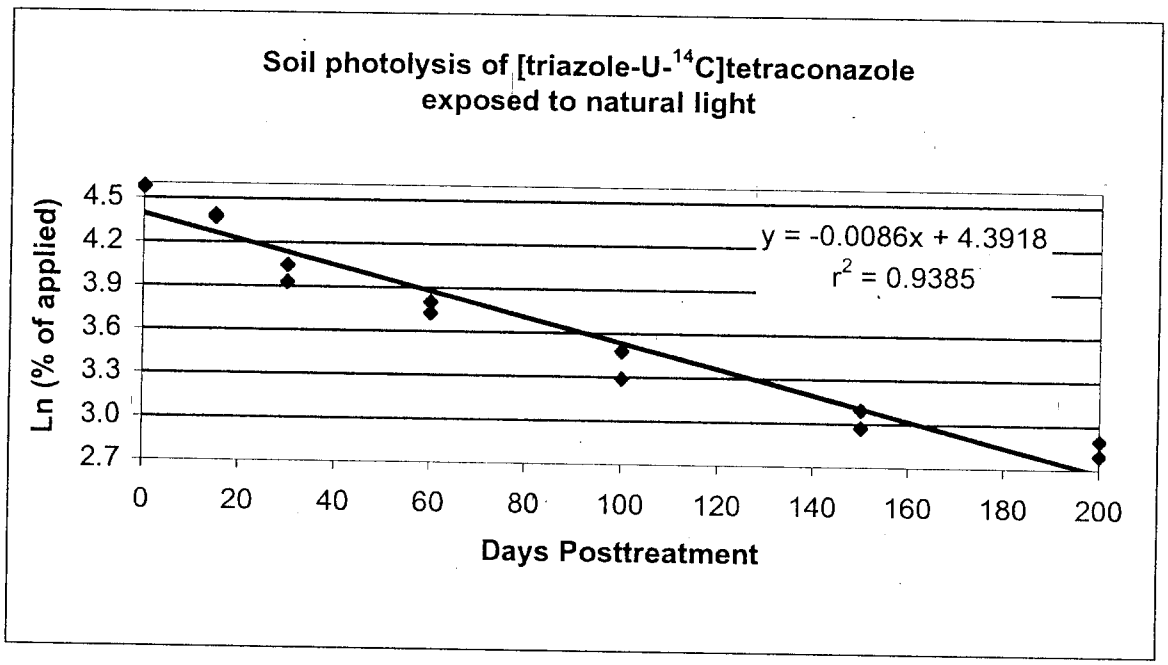
Excel Spreadsheets

Chemical: Tetraconazole
PC: 120603
MRID: 45851802
Guideliene: 161-3

Data obtained fromTable 12, p. 43 in the study report.

Speyer 2.3
Half-life (days) = 80.60

Interval (days)	Tetraconazole (% of applied)	Ln (% of applied)
0	97.85	4.5834
0	97.35	4.5783
15	80.31	4.3859
15	79.13	4.3711
30	50.88	3.9295
30	57.07	4.0443
60	44.72	3.8004
60	41.53	3.7264
100	32.40	3.4782
100	26.86	3.2906
150	19.51	2.9709
150	22.03	3.0924
200	16.41	2.7979
200	18.14	2.8981



Chemical: Tetraconazole
PC: 120603
MRID: 45851802
Guideliene: 161-3

Speyer 2.1

Days	% Recovered
0	99.39
0	98.68
15	97.14
15	95.58
30	97.65
30	97.07
60	97.81
60	96.82
100	93.70
100	90.95
150	92.06
150	89.30
200	79.93
200	80.43
Mean	93.32
ST. Dev.	6.76

Data from p. 35

Speyer 2.2

Days	% Recovered
0	99.58
0	97.09
15	99.73
15	98.13
30	97.35
30	99.54
60	100.50
60	97.87
100	90.27
100	93.76
150	90.58
150	90.50
200	85.02
200	87.62
Mean	94.82
ST. Dev.	5.14

Data from p. 36

Speyer 2.3

Days	% Recovered
0	98.36
0	98.05
15	97.84
15	97.57
30	96.76
30	97.81
60	95.05
60	97.02
100	87.76
100	89.53
150	92.37
150	84.73
200	81.65
200	80.82
Mean	92.52
ST. Dev.	6.00

Data from p. 37

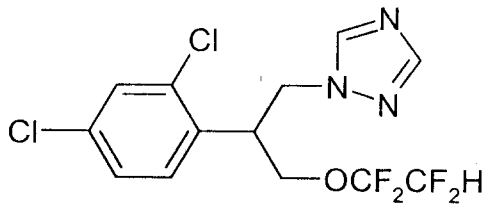
Attachment 2

Structures of Parent and Transformation Products

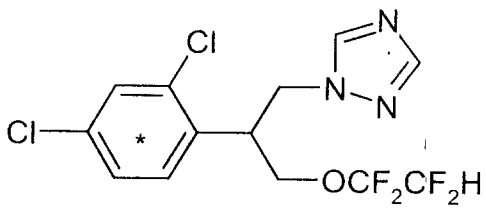
Tetraconazole

IUPAC name: (RS)-2-(2,4-Dichlorophenyl)-3-(1H-1,2,4-triazol-1-yl)propyl 1,1,2,2-tetrafluoroethyl ether
CAS name: 1-[2-(2,4-Dichlorophenyl)-3-(1,1,2,2-tetrafluoroethoxy)propyl]-1H-1,2,4-triazole.
CAS No: 112281-77-3

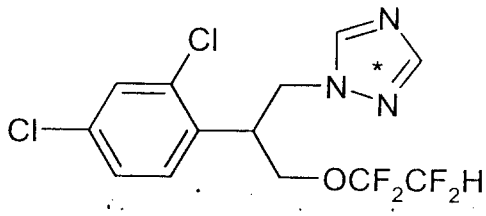
Unlabeled



[Phenyl-U-^{14}C] label



[Triazole-U-^{14}C]label



* Position of the radiolabel.