

US EPA ARCHIVE DOCUMENT

**Data Evaluation Report on the aerobic biotransformation of penoxsulam in soil**

PMRA Submission Number {.....}

EPA MRID Number 45830724

**Data Requirement:** PMRA Data Code:  
EPA DP Barcode: D288160  
OECD Data Point:  
EPA Guideline: 162-1

**Test material:**

Common name: Penoxsulam.

**Chemical names:**

IUPAC: 6-(2,2-Difluoroethoxy)-N-(5,8-dimethoxy-s-triazolo[1,5-c]pyrimidin-2-yl)- $\alpha,\alpha,\alpha$ -trifluoro-o-toluenesulfonamide;  
3-(2,2-Difluoroethoxy)-N-(5,8-dimethoxy[1,2,4]triazolo[1,5-c]pyrimidin-2-yl)- $\alpha,\alpha,\alpha$ -trifluorotoluene-2-sulfonamide.

CAS : 2-(2,2-Difluoroethoxy)-N-(5,8-dimethoxy[1,2,4]triazolo[1,5-c]pyrimidin-2-yl)-6-(trifluoromethyl)benzenesulfonamide.

CAS No: 219714-96-2.

Synonyms: XDE-638 (Petitioner's code).

SMILES string: n1c(nc2n1c(ncc2OC)OC)NS(=O)(=O)c3c(cccc3C(F)(F)F)OCC(F)F.

**Primary Reviewer:** Dana Worcester  
Dynamac Corporation

**Signature:**  
**Date:**

**QC Reviewer:** Joan Gaidos  
Dynamac Corporation

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**Secondary Reviewer:** Lucy Shanaman  
EPA Reviewer

**Signature:** *Lucy Shanaman*  
**Date:** July 22, 2004

**Company Code:**  
**Active Code:**  
**Use Site Category:**  
**EPA PC Code:** 119031

**CITATION:** Krieger, M.S., T.J. Meitl and J.L. Balcer. 2002. Aerobic soil degradation of <sup>14</sup>C-XDE-638. Unpublished study performed by Global Environmental Chemistry Laboratory, Dow AgroSciences LLC, Indianapolis, IN; sponsored and submitted by Dow AgroSciences, LLC, Indianapolis, IN. Study ID: 990051. Experiment initiated July 8, 1999, and completed October 9, 2000 (p.6). Final report issued on February 6, 2002.

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### EXECUTIVE SUMMARY:

The biotransformation of [phenyl- $^{14}\text{C}$ ]- and [triazolopyrimidine-2- $^{14}\text{C}$ ]-labeled 3-(2,2-difluoroethoxy)-N-(5,8-dimethoxy[1,2,4]triazolo[1,5-c]pyrimidin-2-yl)- $\alpha,\alpha,\alpha$ -trifluorotoluene-2-sulfonamide (penoxsulam, XDE-638) was studied in silt loam (pH 5.8, organic carbon 1.17%), clay loam (pH 6.5, organic carbon 3.01%), loam (pH 6.9, organic carbon 3.45%) each from the US for 365 days under aerobic conditions in darkness at  $25 \pm 1^\circ\text{C}$  and soil moisture 75% at 1/3 bar. [ $^{14}\text{C}$ ]Penoxsulam was applied at a nominal rate of 0.075 mg a.i./kg soil dry wt (equivalent to 150 g a.i./ha). This experiment was conducted in accordance with USEPA Subdivision N Guideline §162-1 and US GLP Standards. The test system consisted of biometer flasks containing treated soil (50 g) incubated that were that were connected to biometer side traps with 0.2M sodium hydroxide and an oxygen manifold. The flasks were incubated in darkness in an environmental chamber. Single samples (both labels and all soils) were collected after 0, 1, 3, 7, 14, 30, 60, 91, 179, 270 and 365 days of incubation. Soil samples were extracted once with 0.01  $\text{CaCl}_2$  followed by 3-4 times with acetonitrile:0.1M HCl. Soil extracts, extracted soil and volatile trapping solutions were analyzed for total radioactivity using LSC. Extracts were analyzed for [ $^{14}\text{C}$ ]penoxsulam and its transformation products by reverse-phase HPLC. [ $^{14}\text{C}$ ]Compounds were identified by comparison to reference standards. Identifications of penoxsulam degradates were confirmed using LC/MS.

Test conditions specified in the study methods appear to have been maintained throughout the study. However, only daily temperature data were provided.

Overall recovery of radiolabeled material (both labels) averaged  $99.6 \pm 2.3\%$  (range 96.6-104.0%, n = 20),  $96.0 \pm 4.2\%$  (range 88.3-103.2%, n = 22), and  $95.8 \pm 6.9\%$  (range 85.0-113.2%, n = 22) of the applied in the Arkansas silt loam, California clay loam and North Dakota loam soils. The overall material balances appeared to decline slightly in the California silt loam and North Dakota loam soils.

For both labels in all three soils, major and minor nonvolatile transformation products were identified as 3-[[[2-(2,2-difluoroethoxy)-6-(trifluoromethyl)phenyl]sulfonyl]amino]-1H-1,2,4-triazole-1,5-carboxylic acid (BSTCA), 2-(2,2-difluoroethoxy)-N-1H-1,2,4-triazol-3-yl-6-(trifluoromethyl)-benzenesulfonamide (BST), Methyl 3-[[[2-(2,2-difluoroethoxy)-6-(trifluoromethyl)phenyl]sulfonyl]amino]-1H-1,2,4-triazole-5-carboxylate (BSTCA methyl), 2-(2,2-difluoroethoxy)-N-(5,6-dihydro-8-methoxy-5-oxo [1,2,4-triazolo[1,5-c]pyrimidin-2-yl)-6-(trifluoromethyl)-benzenesulfonamide (5-OH-XDE-638), and 2-(2,2-difluoroethoxy)-N-(iminomethyl-6-(trifluoromethyl)-benzenesulfonamide (SFA).

In Arkansas silt loam soil [TP-2- $^{14}\text{C}$ ]- and [phenyl- $^{14}\text{C}$ ]-labeled penoxsulam decreased from 96.4-100.5% of the applied at day 0 posttreatment to 57.4-64.9% at 7 days, 16.8-19.5% at 30 days and was 1.7-3.0% at 179-365 days.

In [TP-2- $^{14}\text{C}$ ]penoxsulam-treated Arkansas silt loam soil, three major transformation products were identified. BSTCA was a maximum 37.2% of the applied at 365 days. 5-OH-XDE-638 decreased from a maximum 62.6% at 30 days to 8.2% at 365 days. SFA decreased from a maximum 10.7% at

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91 days to 5.3% at 365 days. There were two minor transformation products. BST decreased from a maximum 6.3% at 179 days to 3.5% at 365 days. BSTCA methyl was a maximum of 1.3% at 7-14 days and was not detected thereafter. Extractable [ $^{14}\text{C}$ ]residues decreased from 102.9% of the applied at day 0 to 57.8% at 365 days. Nonextractable [ $^{14}\text{C}$ ]residues increased to maximums of 25.5% (179 days) then decreased to 24.5% at 365 days. Organic matter fractionation of 365-day extracted soil found 16.3%, 1.5% and 6.7% of the applied associated with the fulvic acids, humic acids, and humin respectively. At 365 days, evolved  $^{14}\text{CO}_2$  totaled 16.1% of the applied.

In [phenyl- $^{14}\text{C}$ ] penoxsulam-treated Arkansas silt loam soil, three major transformation products were identified. BSTCA decreased from a maximum 29.3% of the applied at 60 days to 11.5% at 365 days. 5-OH-XDE-638 decreased from a maximum 55.7% at 30 days to 11.1% at 365 days. SFA decreased from a maximum 15.2% at 179 days to 14.7% at 365 days. Sulfonamide increased to a maximum 33.0% of the applied at 365 days. The minor transformation products were: BST decreased from a maximum 3.6% at 179 days and was not detected thereafter, BSTCA methyl was a maximum 1.1% at 14 days and was not detected thereafter. Extractable [ $^{14}\text{C}$ ]residues decreased from 97.9% of the applied at day 0 to 72.8% at 365 days. Nonextractable [ $^{14}\text{C}$ ]residues increased to maximums of 24.2% (179 days) then decreased to 23.2% at 365 days. Organic matter fractionation of 365-day extracted soil found 14.8%, 1.1% and 7.3% of the applied associated with the fulvic acids, humic acids, and humin respectively. At 365 days, evolved  $^{14}\text{CO}_2$  totaled 2.9% of the applied.

In California clay loam soil [TP-2- $^{14}\text{C}$ ]- and [phenyl- $^{14}\text{C}$ ]-labeled penoxsulam decreased from 95.6-100.8% of the applied at day 0 posttreatment to 57.6-64.4% at 7 days, 20.0-24.1% at 30 days, 7.0-9.4% at 60 days and was 1.3-1.5% at 270-365 days.

In [TP-2- $^{14}\text{C}$ ]penoxsulam-treated California clay loam soil, two major transformation products were identified. BSTCA increased to a maximum 32.4% of the applied at 365 days (Appendix C, p.135). 5-OH-XDE-638 decreased from a maximum 36.0% at 30 days to 3.2% at 365 days. SFA decreased from a maximum 3.3% at 179 days to 1.8% at 365 days. There were two minor transformation products. BST decreased from a maximum 4.5% at 91 days to 1.8% at 365 days. BSTCA methyl was a maximum 1.4% at 7 days and was not detected thereafter. Extractable [ $^{14}\text{C}$ ]residues decreased from 101.9% of the applied at day 0 to 40.4% at 365 days. Nonextractable [ $^{14}\text{C}$ ]residues increased to maximums of 55.5% (179 days) then decreased to 43.7% at 365 days. Organic matter fractionation of 365-day extracted soil found 27.0%, 1.2% and 15.5% of the applied associated with the fulvic acids, humic acids, and humin respectively. At 365 days, evolved  $^{14}\text{CO}_2$  totaled 4.2% of the applied.

In [phenyl- $^{14}\text{C}$ ] penoxsulam-treated California clay loam soil, two major transformation products were identified. BSTCA increased to a maximum 32.4% of the applied at 365 days (Appendix C, p.135). 5-OH-XDE-638 decreased from a maximum 40.9% at 30 days to 4.2% at 365 days. There were four minor transformation products. SFA increased to a maximum 2.9% at 365 days. Sulfonamide increased to a maximum 1.4% of the applied at 365 days. BST decreased from a maximum 4.4% at 91 days to 2.9% at 365 days. BSTCA methyl was a maximum 1.4% at 7 days and was not detected thereafter. Extractable [ $^{14}\text{C}$ ]residues decreased from 97.3% of the applied at day 0 to 46.6% at 365 days. Nonextractable [ $^{14}\text{C}$ ]residues increased to maximums of 46.9% (270 days) then

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decreased to 41.9% at 365 days. Organic matter fractionation of 365-day extracted soil found 26.2%, 2.8% and 12.9% of the applied associated with the fulvic acids, humic acids, and humin respectively. At 365 days, evolved  $^{14}\text{CO}_2$  totaled 1.7% of the applied, respectively.

In North Dakota loam soil [TP-2- $^{14}\text{C}$ ]- and [phenyl-U- $^{14}\text{C}$ ]-labeled penoxsulam decreased from 96.4-101.0% of the applied at day 0 posttreatment to 66.5-77.4% at 7 days, 54.2-57.9% at 30 days, 29.9-31.7% at 91 days and was 10.3-11.1% at 365 days.

In [TP-2- $^{14}\text{C}$ ]penoxsulam-treated North Dakota loam soil, two major transformation products were identified. BSTCA increased to a maximum 17.9% of the applied at 365 days. 5-OH-XDE-638 increased to a maximum 24.0% of the applied at 365 days. Extractable [ $^{14}\text{C}$ ]residues decreased from 102.5% of the applied at day 0 to 56.2% at 365 days (Table 9, p.59). Nonextractable [ $^{14}\text{C}$ ]residues increased to maximums of 41.6% (270 days) then decreased to 31.8% at 365 days. Organic matter fractionation of 365-day extracted soil found 24.9%, 0.3% and 6.6% of the applied associated with the fulvic acids, humic acids, and humin respectively. At 365 days, evolved  $^{14}\text{CO}_2$  totaled 0.8% of the applied.

In [phenyl-U- $^{14}\text{C}$ ] penoxsulam-treated North Dakota loam soil, two major transformation products were identified. BSTCA increased to a maximum 20.6% of the applied at 365 days. 5-OH-XDE-638 decreased from a maximum 25.0% at 179 days to 20.6% at 365 days. The minor transformation produced was BST which increased to a maximum 1.8% of the applied at 365 days. Extractable [ $^{14}\text{C}$ ]residues decreased from 97.8% of the applied at day 0 to 55.8% at 365 days (Table 9, p.59). Nonextractable [ $^{14}\text{C}$ ]residues increased to maximums of 54.3% (270 days) then decreased to 28.8% at 365 days. Organic matter fractionation of 365-day extracted soil found 22.3%, 0.2% and 6.2% of the applied associated with the fulvic acids, humic acids, and humin respectively. At 365 days, evolved  $^{14}\text{CO}_2$  totaled 0.4% of the applied.

In a supplementary study to provide degradation information for future residue studies to be carried out in Japan, an additional two Japanese loam soils (pH 5.5, organic carbon 5.10% and pH 5.3, organic carbon 1.84%) were studied for 120 days at  $25 \pm 1^\circ\text{C}$  and soil moisture 40% of moisture holding capacity.

In [TP-2- $^{14}\text{C}$ ] and [phenyl-U- $^{14}\text{C}$ ] penoxsulam-treated volcanic loam soil, penoxsulam decreased from 97.8-103.9% of the applied at day 0 posttreatment to 63.1-64.0% at 14 days, 31.9-34.4% at 62 days and was 18.8-18.9% at 120 days. One major transformation product was identified. 5-OH-XDE-638 increased to a maximum 37.3-39.2% at 90-120 days. Extractable [ $^{14}\text{C}$ ]residues decreased from 99.8-105.5% of the applied at day 0 to 63.5-65.6% at 120 days. Nonextractable [ $^{14}\text{C}$ ]residues increased to maximums of 34.2-37.3% at 90-120 days. Organic matter fractionation of 120-day extracted soil found 25.9-28.1%, 1.6-2.9% and 5.4-5.9% of the applied associated with the fulvic acids, humic acids, and humin respectively. Based on first-order linear regression analysis (Excel 2000), the half-life is 50.2 days.

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In [TP-2-<sup>14</sup>C] and [phenyl-U-<sup>14</sup>C] penoxsulam-treated non-volcanic loam soil, penoxsulam decreased from 96.9-100.5% of the applied at day 0 posttreatment to 49.1-51.9% at 14 days, 20.7-25.9% at 62 days and was 10.9-12.7% at 120 days. Two major transformation products were identified. BSTCA increased to a maximum 14.4-18.0% at 90-120 days. 5-OH-XDE-638 increased to a maximum 44.7-47.0% at 30 days and was 35.0-38.3 at 120 days. Extractable [<sup>14</sup>C]residues decreased from 98.4-104.3% of the applied at day 0 to 69.7-76.8% at 120 days. Nonextractable [<sup>14</sup>C]residues increased to maximums of 21.4-22.5% at 120 days. Organic matter fractionation of 120-day extracted soil found 17.6-18.4%, 0.2-0.7% and 3.4-3.5% of the applied associated with the fulvic acids, humic acids, and humin respectively. Based on first-order linear regression analysis (Excel 2000), the half-life is 41.0 days.

Based on first-order linear regression analysis (Excel 2000), the half-life for penoxsulam was 33.8, 57.3, and 117.5 days in the Arkansas silt loam, California clay loam and North Dakota loam, respectively.

A possible transformation pathway for the degradation of penoxsulam in aerobic soil was proposed by the study author. Penoxsulam could degrade via demethylation of the methoxy group in the 5-position of the TP ring to 2-(2,2-difluoroethoxy)-N-(5,6-dihydro-8-methoxy-5-oxo [1,2,4-triazolo[1,5-c]pyrimidin-2-yl)-6-(trifluoromethyl)-benzenesulfonamide (5-OH-XDE-638). 5-OH-XDE-638 could then degrade via the BSTCA methyl transformation product to 3- [[[2-(2,2-difluoroethoxy)-6-(trifluoromethyl)phenyl]sulfonyl]amino]-1H-1,2,4-triazole-1,5-carboxylic acid (BSTCA). BSTCA could degrade to 2-(2,2-difluoroethoxy)-N-1H-1,2,4-triazol-3-yl-6-(trifluoromethyl)-benzenesulfonamide (BST) and then to 2-(2,2-difluoroethoxy)-N-(iminomethyl)-6-(trifluoromethyl)-benzenesulfonamide (SFA).

### Results Synopsis:

Soil type: Arkansas silt loam.

Half-life (0-179 days): 33.8 days (29 to 40 days at 90% confidence interval;  $r^2 = 0.8366$ ).

Major transformation products:

2-(2,2-difluoroethoxy)-N-(5,6-dihydro-8-methoxy-5-oxo [1,2,4-triazolo[1,5-c]pyrimidin-2-yl)-6-(trifluoromethyl)-benzenesulfonamide (5-OH-XDE-638).

3- [[[2-(2,2-difluoroethoxy)-6-(trifluoromethyl)phenyl]sulfonyl]amino]-1H-1,2,4-triazole-1,5-carboxylic acid (BSTCA).

2-(2,2-difluoroethoxy)-N-(iminomethyl)-6-(trifluoromethyl)-benzenesulfonamide (SFA).

CO<sub>2</sub> (TP label only).

Minor transformation products:

2-(2,2-difluoroethoxy)-N-1H-1,2,4-triazol-3-yl-6-(trifluoromethyl)-benzenesulfonamide (BST).

Methyl 3- [[[2-(2,2-difluoroethoxy)-6-(trifluoromethyl)phenyl]sulfonyl]amino]-1H-1,2,4-triazole-5-carboxylate (BSTCA methyl).

2-(2,2-difluoroethoxy)-6-(trifluoromethyl)-benzenesulfonamide (sulfonamide; phenyl label only).

CO<sub>2</sub> (phenyl label only).

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Soil type: California clay loam.

Half-life (both labels, 0-365 days): 57.3 days (50 to 67 days at 90% confidence interval;  $r^2 = 0.8092$ ).

Major transformation products:

2-(2,2-difluoroethoxy)-N-(5,6-dihydro-8-methoxy-5-oxo [1,2,4-triazolo[1,5-c]pyrimidin-2-yl)-6-(trifluoromethyl)-benzenesulfonamide (5-OH-XDE-638).

3- [[[2-(2,2-difluoroethoxy)-6-(trifluoromethyl)phenyl]sulfonyl]amino]-1H-1,2,4-triazole-1,5-carboxylic acid (BSTCA).

Minor transformation products:

2-(2,2-difluoroethoxy)-N-(iminomethyl)-6-(trifluoromethyl)-benzenesulfonamide (SFA).

2-(2,2-difluoroethoxy)-N-1H-1,2,4-triazol-3-yl-6-(trifluoromethyl)-benzenesulfonamide (BST).

2-(2,2-difluoroethoxy)-6-(trifluoromethyl)-benzenesulfonamide (Sulfonamide; phenyl label only).

Methyl 3- [[[2-(2,2-difluoroethoxy)-6-(trifluoromethyl)phenyl]sulfonyl]amino]-1H-1,2,4-triazole-5-carboxylate (BSTCA methyl).

CO<sub>2</sub>.

Soil type: North Dakota loam.

Half-life (0-365 days): 117.5 days (108 to 128 days at 90% confidence interval;  $r^2 = 0.9236$ ).

Major transformation products:

3- [[[2-(2,2-difluoroethoxy)-6-(trifluoromethyl)phenyl]sulfonyl]amino]-1H-1,2,4-triazole-1,5-carboxylic acid (BSTCA).

2-(2,2-difluoroethoxy)-N-(5,6-dihydro-8-methoxy-5-oxo [1,2,4-triazolo[1,5-c]pyrimidin-2-yl)-6-(trifluoromethyl)-benzenesulfonamide (5-OH-XDE-638).

Minor transformation products:

2-(2,2-difluoroethoxy)-N-1H-1,2,4-triazol-3-yl-6-(trifluoromethyl)-benzenesulfonamide (BST).

CO<sub>2</sub>.

**Study Acceptability:** The study is classified as **acceptable**. It is scientifically valid and satisfies the guideline requirement for an aerobic soil biotransformation study.

### I. MATERIALS AND METHODS

**GUIDELINE FOLLOWED:** This study was designed in accordance with USEPA Subdivision N Guideline §162-1. A supplementary study was conducted to meet Japanese requirements (p.21). No significant deviations from this Subdivision N Guideline §162-1 were noted.

The extraction methods may have been too gentle. Up to 55.5% of the applied radioactivity was not extracted from the three soils. Subdivision N guidelines specify that reasonable nondestructive attempts must be made to extract the parent compound and its transformation products from the test medium. This does not affect the validity of the study.

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**COMPLIANCE:** This study was conducted in compliance with USEPA GLP Standards 40 CFR, Part 160 (p.21). Signed and dated Data Confidentiality, GLP, authenticity and Quality Assurance statements were provided (pp.2-5).

**A. MATERIALS:**

**1. Test Materials:** [Triazolopyrimidine-2-<sup>14</sup>C]- and [phenyl-U-<sup>14</sup>C]-labeled penoxsulam (TP- and Ph-labeled, respectively, p.22).

**Chemical Structure:** See DER Attachment 1.

**Description:** Solid (p.22).

**Purity:**  
**[TP-2-<sup>14</sup>C]:** Radiochemical purity: 99.3% (p.23).  
Batch No.: INV 1456 (p.22).  
Analytical purity: Not reported.  
Specific activity: 28.9 mCi/mmol.  
Location of radiolabel: C2 position in the triazolopyrimidine ring.

**[Phenyl-U-<sup>14</sup>C]:** Radiochemical purity: 98.7% (p.23).  
Batch No.: INV 1475 (p.22).  
Analytical purity: Not reported.  
Specific activity: 24.6 mCi/mmol.  
Location of radiolabel: Uniformly on the phenyl ring.

**Storage conditions of test chemicals:** Not reported.



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Table 1: Physico-chemical properties of penoxsulam.\*

Parameter	Values	Comments
Molecular weight	483	
Molecular formula	Not reported.	
Water solubility (g/L)	0.005 0.41 1.2	At pH 5, and unbuffered. At pH 7. At pH 9.
Other solubilities (g/L)	78.4, DMSO 40.3, NMP 39.8, DMF 20.3, Acetone 15.3, Acetonitrile 3.2, Ethyl Acetate ca. 1.3, Methanol 0.027, Octanol 0.017, Xylene <0.017, Heptane	
Vapor pressure/volatility	$7.16 \times 10^{-16}$ torr	At 25°C.
UV absorption	Not reported.	
pK <sub>a</sub>	5.1	
K <sub>ow</sub> /log K <sub>ow</sub>	-0.354 1.137 -0.602 -1.418	Unbuffered. At pH 5. At pH 7. At pH 9.
Stability of compound at room temperature	Not reported.	After 20 months of storage in a refrigerator, 93.6% of phenyl-labeled penoxsulam remained.

Data obtained from pp.22-23; Appendix E, Table 2, p.151 of the study report.

\* Physico-chemical properties of penoxsulam were reported from preliminary data. The definitive data would be reported in separate reports.

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2. Soil Characteristics:

Table 2: Description of soil collection and storage.

Description	Arkansas silt loam	California clay loam	North Dakota loam
Geographic locations	A dry-seeded rice area in Arkansas County, AR	A water-seeded rice region in Sutter County, CA	A wheat/cereal growing region in Steele County, ND
Pesticide use history at the collection sites	Propanil, Prowl, Grandstand	None	
Collection date	May 23, 1999	June 21, 1999	June 14, 1999
Collection procedures	Hand trowel, 10-12 sites within 50' x 50' plot into plastic 5 gallon bucket.		
Sampling depth	15 cm		
Storage conditions	25 °C	Ambient and 25°C	
Storage length	50 days	18 days	25 days
Preparation	2-mm sieved.		

Data obtained from p.24; Appendix A, p.130 of the study report.

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**Table 3: Properties of the soils.**

Property	Arkansas silt loam	California clay loam	North Dakota loam
Soil texture	Silt loam	Clay loam	Loam
% sand (2000-53 $\mu\text{m}$ )	4.3	33.5	35.5
% silt (53-2 $\mu\text{m}$ )	71.7	32.5	40.5
% clay (<2 $\mu\text{m}$ )	24.0	34.0	24.0
pH	5.8	6.5	6.9
Organic matter (%)	2.02	5.19	5.95
Organic carbon (%)	1.17	3.01	3.45
CEC (meq/100 g)	16.54	21.67	21.99
Field holding capacity at 15 bar (%)	7.55	15.00	16.98
Water holding capacity at 1/3 bar (%)	24.82	29.84	28.53
Bulk density, disturbed ( $\text{g}/\text{cm}^3$ )	1.11	1.18	1.02
Soil Taxonomic classification (USDA)	Fine-silty, mixed, active, thermic Typic Endoaqualls.	Fine, smectitic, thermic Aquic Haploxererts.	Coarse-silty, mixed, superactive, frigid Aeric Calciaquolls (Glyndon) and Coarse-loamy, mixed, superactive, frigid Typic Endoaquolls (Tiffany).
Soil Mapping Unit	Not reported.		
Soil Series	Amagon	Oswald	Glyndon-Tiffany

Data obtained from Table 1, p.50 of the study report.

**B. EXPERIMENTAL CONDITIONS:**

1. Preliminary experiments: None.

2. Experimental conditions:

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Table 4: Study design.

Parameter		Arkansas silt loam	California clay loam	North Dakota loam
Duration of the test		365 days		
Soil condition (air dried/fresh)		Fresh	Fresh	Air dried
Soil (g/replicate)		ca. 50 g dry wt		
Nominal application rate		0.075 mg a.i./kg; equivalent to 150 g a.i./ha assuming 15-cm incorporation and an average bulk density of 1.33 g/cm <sup>3</sup>		
Actual application rate	Sterile controls		Sterile controls were not used	
	Nonsterile treated	Phenyl	0.0795 mg a.i./kg	
		TP	0.0735 mg a.i./kg	
Control conditions, if used		Controls were not used		
No. of Replications	Sterile controls		Sterile controls were not used	
	Nonsterile treated		Single soil samples collected for each radiolabel at each sampling interval	
Test apparatus (Type/material/volume)		Biometer flasks (250 mL Erlenmeyer) containing treated soil (ca. 50 g dry wt.) were adjusted to 75% of 1/3 bar moisture and incubated in the dark in an environmental chamber. Flasks were sealed with a spring tension clip and attached to biometer side traps (125 mL Erlenmeyer caustic trap) connected to oxygen manifolds. The test apparatus is illustrated in Figure 2, p.85.		
Details of traps for CO <sub>2</sub> and organic volatiles, if any		Biometer side traps were filled with 100 mL of 0.2M NaOH and attached to oxygen manifolds that supplied oxygen through a 1/4 inch OD glass tube with an expansion bulb (25 mL). The side trap was sealed with a Teflon swagelok front ferrule with Ace fittings.		
If no traps were used, is the system closed/open?		Volatiles traps were used.		
Identity and concentration of co-solvent	Identity		None. Acetonitrile was evaporated and the test material diluted with water.	
	Final concentration		Solvent was evaporated.	
Test material application	Volume of test solution used/treatment		Nominal: 3.75 µg a.i./flask. Applied: 228-306 µL application solution/flask 3.97 µg [phenyl-U- <sup>14</sup> C]penoxsulam 3.67 µg [TP-2- <sup>14</sup> C]penoxsulam	
	Application method		The application solutions was evenly applied to the soil surface with a positive displacement pipette	
	Is the co-solvent evaporated?		Yes	
Any indication of the test material adsorbing to the walls of the test apparatus?		Not indicated		

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Parameter		Arkansas silt loam	California clay loam	North Dakota loam
Biomass (CFU) of sterile control soil		Sterile controls were not used		
Microbial biomass of the treated soil (CFU/g)		Not reported		
Microbial biomass of the untreated nonsterile soil (CFU/g)		3.3 x 10 <sup>7</sup>	4.9 x 10 <sup>7</sup>	1.8 x 10 <sup>7</sup>
Experimental conditions	Temperature (°C)	25.0 ± 0.5°C		
	Moisture content	75% at 1/3 bar		
	Moisture maintenance method	Soil moisture was not adjusted during the study		
	Continuous darkness	Yes		
Other details, if any		A total of 30 biometer flasks containing soil (50 g dry wt.) and attached to side traps filled with 0.2M NaOH (100 mL) connected to an oxygen manifold were prepared and pre-incubated for 17 days in the dark in an incubator at 25 ± 1.0°C.		

Data obtained from pp.22, 26-28, 39-40; Table 1, p.50 of the study report.

**3. Aerobic conditions:** The biometers were attached to oxygen manifolds, which were checked periodically to insure that oxygen was flowing to the incubators (p.26; Figure 2, p.85). No determinations, such as redox potentials, were made to verify that aerobic conditions were maintained.

**4. Supplementary experiments:** To provide degradation information for future residue studies to be carried out in Japan, the biotransformation of penoxsulam was studied in a volcanic loam (pH 5.5, organic carbon 5.10%) and a non-volcanic loam (pH 5.3, organic carbon 1.84%) each from the Japan for 120 days under aerobic conditions in darkness at 25 ± 1°C and soil moisture 40% of moisture holding capacity (p.26; Table 2, pp.52-53). [<sup>14</sup>C]Penoxsulam was applied at a nominal rate of 0.075 mg a.i./kg soil dry wt. (measured 0.0731 to 0.0804 mg a.i./kg soil dry wt.; p.28). The test system consisted of biometer flasks containing treated soil (50 g) that were connected to biometer side traps with 0.2M sodium hydroxide and an oxygen manifold (p.28). The flasks were incubated in darkness in an environmental chamber, including 6 days of pre-incubation prior to application of the test solution (p.27). Following application, single samples (both labels and all soils) were collected after 0, 1, 3, 7, 14, 30, 62, 90 and 120 days of incubation. Soil samples were extracted once with 0.01 CaCl<sub>2</sub> followed by 3-4 times with acetonitrile:0.1M HCl. Soil extracts, extracted soil and volatile trapping solutions were analyzed for total radioactivity using LSC. Extracts were analyzed for [<sup>14</sup>C]penoxsulam and its transformation products by reverse-phase HPLC. [<sup>14</sup>C]Compounds were identified by comparison to reference standards. Identifications of penoxsulam degradates were confirmed using LC/MS.

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## 5. Sampling:

Table 5: Sampling details.

Criteria	Arkansas silt loam	California clay loam	North Dakota loam
Sampling intervals	0, 1, 3, 7, 14, 30, 60, 91, 179, 270 and 365 days.		
Sampling method	Single flasks of each soil type and label were collected at each sampling interval.		
Method of collection of CO <sub>2</sub> and volatile organic compounds	Trapping solutions were removed from the flasks using a vacuum aspirator system at each sampling interval.		
Sampling intervals/times for Sterility check, if sterile controls are used Moisture content Redox potential/other	Sterile controls were not used. Not adjusted during the study. Not reported.		
Sample storage before analysis	LSC analysis was conducted the day of extraction; HPLC analysis was typically conducted within one week of sampling. p.28. Organic extracts were stored at 6°C.		
Other observations, if any	None.		

Data obtained from pp.28, 29, Table 3, p.53 of the study report.

## C. ANALYTICAL METHODS:

**Extraction/clean up/concentration methods:** The soil was sequentially extracted once with 0.01M CaCl<sub>2</sub> (100 mL) by shaking for 5 minutes, followed by extraction three to four times with acetonitrile:0.01M HCl (90:10, v:v; 70 mL) by shaking on a mechanical shaker for 1 hour per extraction (p.29; Tables 3-4, p.53-54; Figure 5, p.88). After each extraction, the samples were centrifuged (3000 rpm, 10 minutes) and the supernatant was decanted. The extracts were analyzed using LSC. Prior to day 14, CaCl<sub>2</sub> extracts were partitioned twice with dichloromethane (DCM), evaporated to dryness, reconstituted in water:acetonitrile (95:5) and analyzed by HPLC. The aqueous fraction was freeze dried, reconstituted in water:acetonitrile, filtered (0.45 µm PTFE syringe filter) and analyzed by HPLC (p.30). CaCl<sub>2</sub> extracts from days 14-365 were freeze dried, reconstituted in water:acetonitrile, filtered (0.2 µm PTFE syringe filter) and analyzed by HPLC. The organic extracts were filtered (0.45 µm PTFE syringe filter), concentrated by rotary evaporation under a stream of nitrogen at 35-40°C, reconstituted in water:acetonitrile (95:5), filtered (0.2 µm syringe filter) and analyzed by HPLC.

**Nonextractable residue determination:** Extracted soil was air-dried, ground, then aliquots (1 g) were analyzed for total radioactivity by LSC following combustion (p.31).

To separate nonextractable [<sup>14</sup>C]residues into humin, humic acids and fulvic acids fractions, 365-day extracted, air-dried soil samples (10 g) were further extracted with 0.5M NaOH (50 mL) at ambient

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temperature for 24 hours using a mechanical shaker (p.31). Extract was separated from soil by centrifugation (3,000 rpm for 15 minutes) and decanted. The soils was extracted a second time with 0.5M NaOH (10 mL). The extracts were combined, acidified to pH 2 and allowed to stand for 24 hours at ambient temperature. The resulting precipitate (humic acids) was removed by centrifugation (3,000 rpm for 15 minutes). Triplicate aliquots (5 mL x 3) of the supernatant (fulvic acids) were analyzed by LSC. The precipitate (humic acids) were redissolved in 0.5M NaOH and triplicate aliquots were analyzed by LSC.

**Volatile residue determination:** Triplicate aliquots (1-2 mL) of the trapping solutions were analyzed for total radioactivity using LSC (p.29). The presence of  $^{14}\text{CO}_2$  was not confirmed.

**Total  $^{14}\text{C}$  measurement:** Total  $^{14}\text{C}$  residues were determined by summation of the concentrations of residues measured in the soil extracts, extracted soil, and volatile trapping solutions (p.33).

**Derivatization method, if used:** A derivatization method was not employed.

**Identification and quantification of parent compound:** Soil extracts were analyzed using reverse-phase HPLC (system 1) under the following conditions: YMC ODS-AQ C18 column (4.6 x 250 mm, 5  $\mu$ ), gradient mobile phase combining: (A) water and 1% acetic acid and (B) acetonitrile and 1% acetic acid: Method 1 (days 0, 1, 3, 7) [percent A:B at 0 min. 95:5, 40-40.01 min. 5:95, 45-45.01 min. 95:5], Method 2 (days 14, 30, 60, 91, 179) [percent A:B at 0 min. 70:30, 40 min. 30:70, 40.01-45 min. 5:95, 45.01 min. 70:30], Method 3 (days 270, 365) [percent A:B at 0 min. 98:2, 40 min. 30:70, 40.01-45 min. 5:95, 45.01 min. 98:2], flow rate 1.0 mL/minute (Table 4, p.54, Appendix B, p.132). HPLC column recoveries were reported as 90-110% of the applied for all samples, but supporting data were not provided (p.40). [ $^{14}\text{C}$ ]Penoxsulam was identified by comparison to retention times of unlabeled reference standard.

**Identification and quantification of transformation products:** Transformation products were separated and quantified using HPLC as described for the parent. Identification of the transformation products was confirmed using LC/MS with ESI (electrospray ionization) operated in negative and positive modes (p.42; Appendix E, pp.146-149). The reference standards used were (pp.23, 82-84):

2-(2,2-difluoroethoxy)-N-(5,6-dihydro-8-methoxy-5-oxo [1,2,4]triazolo[1,5-c]pyrimidin-2-yl)-6-(trifluoromethyl)benzenesulfonamide (5-OH-XDE-638),

3- [[[2-(2,2-difluoroethoxy)-6-(trifluoromethyl)phenyl]sulfonyl]amino]-1H-1,2,4-triazole-1,5-carboxylic acid (BSTCA),

2-(2,2-difluoroethoxy)-N-1H-1,2,4-triazol-3-yl-6-(trifluoromethyl)-benzenesulfonamide (BST),

methyl 3- [[[2-(2,2-difluoroethoxy)-6-(trifluoromethyl)phenyl]sulfonyl]amino]-1H-1,2,4-triazole-5-carboxylate (BSTCA methyl),

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2-(2,2-difluoroethoxy)-N-(iminomethyl-6-(trifluoromethyl)-benzenesulfonamide (SFA),

2-(2,2-difluoroethoxy)-6-(trifluoromethyl)-benzenesulfonamide (Sulfonamide).

## HPLC Retention times.

Transformation product	Method 1 (95/5) minutes	Method 2 (70/30) minutes	Method 3 (98/2) minutes
Penoxsulam	23.6	35.2	23.2
Sulfonamide	21.1	30.3	16.9
5-OH-XDE-638	20.3	29.7	15.5
BSTCA methyl	20.0	28.6	14.6
SFA	18.9	26.6	12.8
BST	17.7	24.8	11.0
BSTCA	15.6	21.5	9.1

Data obtained from Appendix B, p.132 of the study report.

**Detection limits (LOD, LOQ) for the parent compound and transformation products:** The limits of detection (LOD) were 0.070% (0.05 ppb), 0.666% (0.5 ppb), 0.00005% (0.04 ppt), and 0.0007% (0.5 ppt) of the applied in the trapping solution, organic extract, combusted soil and HPLC, respectively (pp.37-38). The limits of quantification (LOQ) were 0.267% (0.2 ppb), 2.92% (2 ppb), 0.00023% (0.2 ppt) and 0.003% (2 ppt) of the applied in the trapping solution, organic extract, combusted soil and HPLC, respectively.

## II. RESULTS AND DISCUSSION:

**A. TEST CONDITIONS:** It was reported that aerobicity, moisture, temperature and other environmental conditions were maintained throughout the study. However, no supporting data is provided (p.39).

**B. MATERIAL BALANCE:** Overall recovery of radiolabeled material (both labels) averaged  $99.6 \pm 2.3\%$  (range 96.6-104.0%, n = 20),  $96.0 \pm 4.2\%$  (range 88.3-103.2%, n = 22), and  $95.8 \pm 6.9\%$  (range 85.0-113.2%, n = 22) of the applied in the Arkansas silt loam, California clay loam and North Dakota loam soils (calculated from Tables 7-9, pp.57-59; Appendix C, pp.134-136). The overall material balances appeared to decline slightly in the California silt loam and North Dakota loam soils.

In [TP-2-<sup>14</sup>C]-label treated soils, recoveries averaged (n = 10 to 12)  $101.2 \pm 2.0\%$  (98.2-104.0%),  $96.9 \pm 4.6\%$  (88.3-103.2%) and  $95.9 \pm 6.7\%$  (86.8-103.8%) in the silt loam, clay loam and loam soils,

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respectively. In [phenyl-U-<sup>14</sup>C]-label treated soils, recoveries averaged (n = 10 to 12) 97.9 ± 0.9% (96.6-99.1%), 94.1 ± 3.4% (88.8-98.5%) and 95.8 ± 7.4% (85.0-113.2%) in the silt loam, clay loam and loam soils, respectively.

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Table 6: Biotransformation of [TP-2-<sup>14</sup>C]penoxsulam, expressed as percentage of applied radioactivity (n = 1), in Arkansas silt loam soil under aerobic conditions.

Compound	Sampling times (days)									
	0	1	3	7	14	30	60	91	179	365
Penoxsulam	100.5	88.8	76.0	64.9	36.5	16.8	7.1	5.1	2.7	1.9
BSTCA	ND	ND	ND	ND	2.8	4.7	30.1	21.6	28.1	37.2
BST	ND	ND	ND	ND	0.4	0.7	0.8	1.1	6.3	3.5
SFA	ND	ND	ND	ND	0.5	1.2	6.2	10.7	5.9	5.3
BSTCA methyl	ND	ND	1.2	0.5	1.3	1.3	ND	ND	ND	ND
5-OH-XDE-638	0.4	9.3	19.2	27.7	49.7	62.6	33.5	29.1	15.9	8.2
Sulfonamide	N/A									
Total extractable residues*	102.9	98.9	97.4	94.2	92.9	88.7	81.9	73.9	68.2	57.8
CO <sub>2</sub> *	0.0	0.0	0.0	0.1	0.2	0.6	2.2	4.2	7.1	16.1
Volatile organic	Not reported.									
Nonextractable residues*	1.1	2.2	4.0	5.5	10.6	13.2	18.6	20.1	25.5	24.5
Total % recovery*	104.0	101.1	101.4	99.8	103.6	102.5	102.6	98.2	100.8	98.4

Data obtained from Table 7, p.57 and Appendix C, p.134 of the study report.

\* The differences in the data between Table 7 and Appendix C were reportedly due to rounding errors and clean-up/chromatographic losses.

N/A = Not applicable.

ND = Not detected.

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**Table 7: Biotransformation of [phenyl-U-<sup>14</sup>C]penoxsulam, expressed as percentage of applied radioactivity (n = 1), in Arkansas silt loam soil under aerobic conditions.**

Compound	Sampling times (days)									
	0	1	3	7	14	30	60	91	179	365
Penoxsulam	96.4	88.8	76.6	57.4	37.4	19.5	7.9	5.5	3.0	1.7
BSTCA	ND	ND	ND	ND	3.9	6.1	29.3	21.4	15.5	11.5
BST	ND	ND	ND	ND	ND	0.4	0.4	2.6	3.6	ND
SFA	ND	ND	ND	ND	0.4	0.9	5.9	10.6	15.2	14.7
BSTCA methyl	ND	ND	ND	0.8	1.1	ND	ND	ND	ND	ND
5-OH-XDE-638	1.5	7.8	16.8	32.7	43.5	55.7	29.6	23.4	16.7	11.1
Sulfonamide	ND	ND	ND	ND	ND	ND	3.0	4.8	12.0	33.0
Total extractable residues*	97.9	97.1	94.5	91.9	87.4	84.6	78.8	76.8	71.9	72.8
CO <sub>2</sub> *	0.0	0.0	0.0	0.0	0.1	0.2	0.3	0.5	1.3	2.9
Volatile organic	Not reported.									
Nonextractable residues*	0.9	2.1	3.9	5.9	10.6	11.8	17.8	19.7	24.2	23.2
Total % recovery*	98.8	99.1	98.4	97.8	98.2	96.6	96.9	96.9	97.5	98.9

Data obtained from Table 7, p.57 and Appendix C, p.134 of the study report.

\* The differences in the data between Table 7 and Appendix C were reportedly due to rounding errors and clean-up/chromatographic losses.

N/A = Not applicable.

ND = Not detected.

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**Table 8: Biotransformation of [TP-2-<sup>14</sup>C]penoxsulam, expressed as percentage of applied radioactivity (n = 1), in California clay loam soil under aerobic conditions.**

Compound	Sampling times (days)										
	0	1	3	7	14	30	60	91	179	270	365
Penoxsulam	100.8	89.5	78.1	57.6	37.6	20.0	7.0	4.4	2.1	1.5	1.3
BSTCA	ND	ND	ND	ND	3.6	6.4	24.5	24.4	22.7	27.2	32.4
BST	ND	ND	ND	ND	ND	0.5	2.9	4.5	3.9	2.3	1.8
SFA	ND	ND	ND	ND	ND	ND	1.7	2.4	3.3	3.2	1.8
BSTCA methyl	ND	ND	0.6	1.4	ND	ND	ND	ND	ND	ND	ND
5-OH-XDE-638	0.6	6.4	14.7	24.6	34.5	36.0	17.5	12.3	5.5	3.6	3.2
Sulfonamide	N/A										
Total extractable residues*	101.9	97.3	94.9	84.6	78.7	71.9	56.8	51.7	42.2	38.8	40.4
CO <sub>2</sub> *	0.0	0.0	0.0	0.0	0.1	0.3	0.9	1.2	3.0	3.8	4.2
Volatile organic	Not reported.										
Nonextractable residues*	1.2	3.4	6.4	10.9	21.3	21.2	34.9	41.2	55.5	53.8	43.7
Total % recovery*	103.2	100.7	101.4	95.5	100.1	93.4	92.5	94.1	100.7	96.3	88.3

Data obtained from Table 8, p.58 and Appendix C, p.135 of the study report.

\* The differences in the data between Table 8 and Appendix C were reportedly due to rounding errors and clean-up/chromatographic losses.

N/A = Not applicable.

ND = Not detected.

(A)

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Table 9: Biotransformation of [Phenyl-U-<sup>14</sup>C]penoxsulam, expressed as percentage of applied radioactivity (n = 1), in California clay loam soil under aerobic conditions.

Compound	Sampling times (days)										
	0	1	3	7	14	30	60	91	179	270	365
Penoxsulam	95.6	86.8	75.7	64.4	43.0	24.1	9.4	5.4	--	1.3	1.4
BSTCA	ND	ND	ND	ND	3.1	5.6	25.6	23.8	--	27.3	32.4
BST	ND	ND	ND	ND	ND	0.7	0.3	4.4	--	3.0	2.9
SFA	ND	ND	ND	ND	ND	ND	1.1	1.7	--	2.7	2.9
BSTCA methyl	ND	ND	0.6	1.4	ND	ND	ND	ND	--	ND	ND
5-OH-XDE-638	1.5	8.4	12.6	22.1	34.0	40.9	21.0	15.8	--	5.2	4.2
Sulfonamide	ND	ND	ND	ND	ND	ND	ND	ND	--	0.5	1.4
Total extractable residues*	97.3	95.6	89.6	88.6	81.0	73.9	60.7	54.8	--	40.3	46.6
CO <sub>2</sub> *	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.5	--	1.6	1.7
Volatile organic	Not reported.										
Nonextractable residues*	1.2	2.8	5.3	9.1	13.9	19.9	30.2	37.1	--	46.9	41.9
Total % recovery*	98.5	98.4	94.9	97.7	95.0	93.9	91.3	92.5	--	88.8	90.2

Data obtained from Table 8, p.58 and Appendix C, p.135 of the study report .

\* The differences in the data between Table 8 and Appendix C were reportedly due to rounding errors and clean-up/chromatographic losses.

-- Data was not provided due to analytical errors.

ND = Not detected.

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Table 10: Biotransformation of [TP-2-<sup>14</sup>C]penoxsulam, expressed as percentage of applied radioactivity (n = 1), in North Dakota loam soil under aerobic conditions.

Compound	Sampling times (days)										
	0	1	3	7	14	30	60	91	179	270	365
Penoxsulam	101.0	92.4	84.4	66.5	69.3	54.2	38.6	29.9	21.7	13.2	10.3
BSTCA	ND	ND	ND	ND	0.6	1.1	7.0	5.8	10.6	14.9	17.9
BST	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SFA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BSTCA methyl	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5-OH-XDE-638	0.7	2.5	4.1	17.1	11.8	17.8	20.7	21.1	18.6	19.4	24.0
Sulfonamide	N/A										
Total extractable residues*	102.5	95.4	89.7	84.1	82.0	74.0	68.9	60.1	52.8	48.8	56.2
CO <sub>2</sub> *	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.5	0.8
Volatile organic	Not reported.										
Nonextractable residues*	1.3	8.3	11.6	17.5	19.1	19.7	26.4	26.5	34.1	41.6	31.8
Total % recovery*	103.8	103.7	101.4	101.7	101.1	93.8	95.4	86.8	87.1	90.9	88.8

Data obtained from Table 9, p.59 and Appendix C, p.136 of the study report.

\* The differences in the data between Table 9 and Appendix C were reportedly due to rounding errors and clean-up/chromatographic losses.

N/A = Not applicable.

ND = Not detected.

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Table 11: Biotransformation of [Phenyl-U-<sup>14</sup>C]penoxsulam, expressed as percentage of applied radioactivity (n = 1), in North Dakota loam soil under aerobic conditions.

Compound	Sampling times (days)										
	0	1	3	7	14	30	60	91	179	270	365
Penoxsulam	96.4	87.9	78.8	77.4	67.1	57.9	40.6	31.7	20.6	16.8	11.1
BSTCA	ND	ND	ND	ND	0.7	1.0	5.3	6.8	10.1	16.2	20.6
BST	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.1	1.8
SFA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BSTCA methyl	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5-OH-XDE-638	0.8	3.3	4.5	8.4	10.8	19.2	21.7	23.8	25.0	21.7	20.6
Sulfonamide	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total extractable residues*	97.8	91.3	83.6	86.1	79.0	79.0	69.4	64.2	58.7	58.3	55.8
CO <sub>2</sub> *	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.3	0.7	0.7	0.4
Volatile organic	Not reported.										
Nonextractable residues*	0.9	6.5	9.7	14.0	18.5	15.6	25.0	23.7	31.2	54.3	28.8
Total % recovery*	98.8	97.9	93.3	100.1	97.5	94.7	94.7	88.3	90.7	113.2	85.0

Data obtained from Table 9, p.59 and Appendix C, p.136 of the study report.

\* The differences between Table 9 and Appendix C were reportedly due to rounding errors and clean-up/chromatographic losses.

ND = Not detected.

**C. TRANSFORMATION OF PARENT COMPOUND:** In Arkansas silt loam soil [TP-2-<sup>14</sup>C]- and [phenyl-U-<sup>14</sup>C]-labeled penoxsulam decreased from 96.4-100.5% of the applied at day 0 posttreatment to 57.4-64.9% at 7 days, 16.8-19.5% at 30 days and was 1.7-3.0% at 179-365 days (Appendix C, p.134).

In California clay loam soil [TP-2-<sup>14</sup>C]- and [phenyl-U-<sup>14</sup>C]-labeled penoxsulam decreased from 95.6-100.8% of the applied at day 0 posttreatment to 57.6-64.4% at 7 days, 20.0-24.1% at 30 days, 7.0-9.4% at 60 days and was 1.3-1.5% at 270-365 days (Appendix C, p.135).

In North Dakota loam soil [TP-2-<sup>14</sup>C]- and [phenyl-U-<sup>14</sup>C]-labeled penoxsulam decreased from 96.4-101.0% of the applied at day 0 posttreatment to 66.5-77.4% at 7 days, 54.2-57.9% at 30 days, 29.9-31.7% at 91 days and was 10.3-11.1% at 365 days (Appendix C, p.136).

**HALF-LIFE/DT50:** Based on first-order linear regression analysis (Excel 2000), the half-life for penoxsulam was 33.8, 57.3, and 117.5 days in the Arkansas silt loam, California clay loam and North Dakota loam, respectively.

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Table 12: DT50/DT90 values of penoxsulam in aerobic soil.

Soil	First order Linear			DT50	DT90*
	Half-life (days)	Regression equation	r <sup>2</sup>		
Arkansas silt loam	33.80	y = -0.020x + 4.07202	0.8366	ND	209 (34)
California clay loam	57.28	y = -0.0121x + 3.8291	0.8092	ND	191 (37)
North Dakota loam	117.48	y = -0.0059x + 4.3042	0.9236	ND	391 (N/A)

Data obtained from Table 23, p.73, Appendix C, pp.134-136 of the study report.

The DT90 was reported based on first-order linear regression analysis and (non-linear) analysis using on ModelMaker (v. 3 and 4).

ND = Not determined.

N/A = Regression not performed.

**TRANSFORMATION PRODUCTS:** For both labels in all three soils, major and minor nonvolatile transformation products were identified as 3- [[[2-(2,2-difluoroethoxy)-6-(trifluoromethyl)phenyl]sulfonyl]amino]-1H-1,2,4-triazole-1,5-carboxylic acid (BSTCA); 2-(2,2-difluoroethoxy)-N-1H-1,2,4-triazol-3-yl-6-(trifluoromethyl)-benzenesulfonamide (BST); Methyl 3- [[[2-(2,2-difluoroethoxy)-6-(trifluoromethyl)phenyl]sulfonyl]amino]-1H-1,2,4-triazole-5-carboxylate (BSTCA methyl); 2-(2,2-difluoroethoxy)-N-(5,6-dihydro-8-methoxy-5-oxo [1,2,4-triazolo[1,5-c]pyrimidin-2-yl)-6-(trifluoromethyl)-benzenesulfonamide (5-OH-XDE-638); and 2-(2,2-difluoroethoxy)-N-(iminomethyl-6-(trifluoromethyl)-benzenesulfonamide (SFA) (pp.82-84).

In [TP-2-<sup>14</sup>C]penoxsulam-treated Arkansas silt loam soil, three major transformation products were identified. BSTCA was a maximum 37.2% of the applied at 365 days (Appendix C, p.134). 5-OH-XDE-638 decreased from a maximum 62.6% at 30 days to 8.2% at 365 days. SFA decreased from a maximum 10.7% at 91 days to 5.3% at 365 days. There were two minor transformation products: BST decreased from a maximum 6.3% at 179 days to 3.5% at 365 days, and BSTCA methyl was a maximum of 1.3% at 7-14 days, and was not detected thereafter.

In [phenyl-U-<sup>14</sup>C] penoxsulam-treated Arkansas silt loam soil, four major transformation products were identified. BSTCA decreased from a maximum 29.3% of the applied at 60 days to 11.5% at 365 days (Appendix C, p.134). 5-OH-XDE-638 decreased from a maximum 55.7% at 30 days to 11.1% at 365 days. SFA decreased from a maximum 15.2% at 179 days to 14.7% at 365 days. Sulfonamide increased to a maximum 33.0% of the applied at 365 days. There were two minor transformation products. BST decreased from a maximum 3.6% at 179 days and was not detected thereafter. BSTCA methyl was a maximum 1.1% at 14 days, and was not detected thereafter.

In [TP-2-<sup>14</sup>C]penoxsulam-treated California clay loam soil, two major transformation products were identified. BSTCA increased to a maximum 32.4% of the applied at 365 days (Appendix C, p.135). 5-OH-XDE-638 decreased from a maximum 36.0% at 30 days to 3.2% at 365 days. There were three minor transformation products. SFA decreased from a maximum 3.3% at 179 days to 1.8% at 365 days. BST decreased from a maximum 4.5% at 91 days to 1.8% at 365 days. BSTCA methyl was a maximum 1.4% at 7 days, and was not detected thereafter.

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## Data Evaluation Report on the aerobic biotransformation of penoxsulam in soil

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In [phenyl-U-<sup>14</sup>C] penoxsulam-treated California clay loam soil, two major transformation products were identified. BSTCA increased to a maximum 32.4% of the applied at 365 days (Appendix C, p.135). 5-OH-XDE-638 decreased from a maximum 40.9% at 30 days to 4.2% at 365 days. There were four minor transformation products. SFA increased to a maximum 2.9% at 365 days. Sulfonamide increased to a maximum 1.4% of the applied at 365 days. BST decreased from a maximum 4.4% at 91 days to 2.9% at 365 days. BSTCA methyl was a maximum 1.4% at 7 days, and was not detected thereafter.

In [TP-2-<sup>14</sup>C]penoxsulam-treated North Dakota loam soil, two major transformation products were identified. BSTCA increased to a maximum 17.9% of the applied at 365 days (Appendix C, p.136). 5-OH-XDE-638 increased to a maximum 24.0% of the applied at 365 days.

In [phenyl-U-<sup>14</sup>C] penoxsulam-treated North Dakota loam soil, two major transformation products were identified. BSTCA increased to a maximum 20.6% of the applied at 365 days (Appendix C, p.136). 5-OH-XDE-638 decreased from a maximum 25.0% at 179 days to 20.6% at 365 days. There was one minor transformation product. BST increased to a maximum 1.8% of the applied at 365 days.

**NONEXTRACTABLE AND EXTRACTABLE RESIDUES:** In [TP-2-<sup>14</sup>C]penoxsulam-treated Arkansas silt loam soil, extractable [<sup>14</sup>C]residues decreased from 102.9% of the applied at day 0 to 57.8% at 365 days (Table 7, p.57). Nonextractable [<sup>14</sup>C]residues increased to a maximum of 25.5% (179 days) then decreased to 24.5% at 365 days. Organic matter fractionation of 365-day extracted soil found 16.3%, 1.5% and 6.7% of the applied associated with the fulvic acids, humic acids, and humin respectively (Table 22, p.72).

In [phenyl-U-<sup>14</sup>C] penoxsulam-treated Arkansas silt loam soil, extractable [<sup>14</sup>C]residues decreased from 97.9% of the applied at day 0 to 72.8% at 365 days (Table 7, p.57). Nonextractable [<sup>14</sup>C]residues increased to maximums of 24.2% (179 days) then decreased to 23.2% at 365 days. Organic matter fractionation of 365-day extracted soil found 14.8%, 1.1% and 7.3% of the applied associated with the fulvic acids, humic acids, and humin respectively (Table 22, p.72).

In [TP-2-<sup>14</sup>C]penoxsulam-treated California clay loam soil, extractable [<sup>14</sup>C]residues decreased from 101.9% of the applied at day 0 to 40.4% at 365 days (Table 8, p.58). Nonextractable [<sup>14</sup>C]residues increased to maximums of 55.5% (179 days) then decreased to 43.7% at 365 days. Organic matter fractionation of 365-day extracted soil found 27.0%, 1.2% and 15.5% of the applied associated with the fulvic acids, humic acids, and humin respectively (Table 22, p.72).

In [phenyl-U-<sup>14</sup>C] penoxsulam-treated California clay loam soil, extractable [<sup>14</sup>C]residues decreased from 97.3% of the applied at day 0 to 46.6% at 365 days (Table 8, p.58). Nonextractable [<sup>14</sup>C]residues increased to maximums of 46.9% (270 days) then decreased to 41.9% at 365 days. Organic matter fractionation of 365-day extracted soil found 26.2%, 2.8% and 12.9% of the applied associated with the fulvic acids, humic acids, and humin respectively (Table 22, p.72).

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In [TP-2-<sup>14</sup>C]penoxsulam-treated North Dakota loam soil, extractable [<sup>14</sup>C]residues decreased from 102.5% of the applied at day 0 to 56.2% at 365 days (Table 9, p.59). Nonextractable [<sup>14</sup>C]residues increased to maximums of 41.6% (270 days) then decreased to 31.8% at 365 days. Organic matter fractionation of 365-day extracted soil found 24.9%, 0.3% and 6.6% of the applied associated with the fulvic acids, humic acids, and humin respectively (Table 22, p.72).

In [phenyl-U-<sup>14</sup>C] penoxsulam-treated North Dakota loam soil, extractable [<sup>14</sup>C]residues decreased from 97.8% of the applied at day 0 to 55.8% at 365 days (Table 9, p.59). Nonextractable [<sup>14</sup>C]residues increased to maximums of 54.3% (270 days) then decreased to 28.8% at 365 days. Organic matter fractionation of 365-day extracted soil found 22.3%, 0.2% and 6.2% of the applied associated with the fulvic acids, humic acids, and humin respectively (Table 22, p.72).

**VOLATILIZATION:** In [TP-2-<sup>14</sup>C]penoxsulam-treated Arkansas silt loam soil, volatilized <sup>14</sup>CO<sub>2</sub> was significant, totaling 16.1% of the applied radioactivity at the final interval (365 days; Table 7, p.57). In the remaining soils, volatilized <sup>14</sup>CO<sub>2</sub> was insignificant, totaling ≤4.2% of the applied radioactivity at the final interval (365 days; Tables 7-9, pp.57-59).

**TRANSFORMATION PATHWAY:** A possible transformation pathway for the degradation of penoxsulam in aerobic soil was proposed by the study author (p.46, Figure 45, p.128). Penoxsulam degrades via demethylation of the methoxy group in the 5-position of the TP ring to 2-(2,2-difluoroethoxy)-N-(5,6-dihydro-8-methoxy-5-oxo [1,2,4-triazolo[1,5-c]pyrimidin-2-yl)-6-(trifluoromethyl)-benzenesulfonamide (5-OH-XDE-638). 5-OH-XDE-638 degrades via the BSTCA methyl transformation product to 3-[[[2-(2,2-difluoroethoxy)-6-(trifluoromethyl)phenyl]sulfonyl]amino]-1H-1,2,4-triazole-1,5-carboxylic acid (BSTCA). BSTCA degraded to 2-(2,2-difluoroethoxy)-N-1H-1,2,4-triazol-3-yl-6-(trifluoromethyl)-benzenesulfonamide (BST) and then to 2-(2,2-difluoroethoxy)-N-(iminomethyl-6-(trifluoromethyl)-benzenesulfonamide (SFA).

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Table 13: Chemical names for identified transformation products of penoxsulam in aerobic soil.

Applicant's code	CAS Number	Chemical Name	Chemical formula	Molecular weight	SMILES string
5-OH-XDE-638	--	2-(2,2-Difluoroethoxy)-N-(5,6-dihydro-8-methoxy-5-oxo [1,2,4-triazolo[1,5-c]pyrimidin-2-yl)-6-(trifluoromethyl)-benzenesulfonamide	-	469	--
BSTCA	--	3- [[[2-(2,2-Difluoroethoxy)-6-(trifluoromethyl)phenyl]sulfonyl]amino]-1H-1,2,4-triazole-1,5-carboxylic acid	--	416	--
BST	--	2-(2,2-Difluoroethoxy)-N-1H-1,2,4-triazol-3-yl-6-(trifluoromethyl)-benzenesulfonamide	--	372	--
SFA	--	2-(2,2-Difluoroethoxy)-N-(iminomethyl-6-(trifluoromethyl)-benzenesulfonamide	--	332	--
BSTCA methyl	--	Methyl 3- [[[2-(2,2-difluoroethoxy)-6-(trifluoromethyl)phenyl]sulfonyl]amino]-1H-1,2,4-triazole-5-carboxylate	--	430	--
Sulfonamide	--	2-(2,2-Difluoroethoxy)-6-(trifluoromethyl)-benzenesulfonamide	--	305	--

Data obtained from pp.82-84 of the study report.

-- Not reported.

**D. SUPPLEMENTARY EXPERIMENT-RESULTS:** In [TP-2-<sup>14</sup>C] and [phenyl-U-<sup>14</sup>C] penoxsulam-treated volcanic loam soil penoxsulam decreased from 97.8-103.9% of the applied at day 0 posttreatment to 63.1-64.0% at 14 days, 31.9-34.4% at 62 days and was 18.8-18.9% at 120 days (Appendix C, p.137). One major transformation product was identified. 5-OH-XDE-638 increased to a maximum 37.3-39.2% at 90-120 days. BSTCA increased to a maximum 4.4% of the applied at 120 days. Extractable [<sup>14</sup>C]residues decreased from 99.8-105.5% of the applied at day 0 to 63.5-65.6% at 120 days (Table 10, p.60). Nonextractable [<sup>14</sup>C]residues increased to maximums of 34.2-37.3% at 90-120 days. Organic matter fractionation of 120-day extracted soil found 25.9-28.1%, 1.6-2.9% and 5.4-5.9% of the applied associated with the fulvic acids, humic acids, and humin respectively (Table 22, p.72). Volatilized <sup>14</sup>CO<sub>2</sub> was insignificant totaling ≤0.2% of the applied radioactivity at the final interval (120 days). Based on first-order linear regression analysis (Excel 2000), the half-life is 50.2 days.

In [TP-2-<sup>14</sup>C] and [phenyl-U-<sup>14</sup>C] penoxsulam-treated non-volcanic loam soil penoxsulam decreased from 96.9-100.5% of the applied at day 0 posttreatment to 49.1-51.9% at 14 days, 20.7-25.9% at 62 days and was 10.9-12.7% at 120 days (Appendix C, p.138). Two major transformation products were identified. BSTCA increased to a maximum 14.4-18.0% at 90-120 days. 5-OH-XDE-638 increased to a maximum 44.7-47.0% at 30 days and was 35.0-38.3 at 120 days. Extractable [<sup>14</sup>C]residues decreased from 98.4-104.3% of the applied at day 0 to 69.7-76.8% at 120 days (Table 11, p.61). Nonextractable [<sup>14</sup>C]residues increased to maximums of 21.4-22.5% at 120 days. Organic matter fractionation of 120-day extracted soil found 17.6-18.4%, 0.2-0.7% and 3.4-3.5% of the applied

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PMRA Submission Number {.....}

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associated with the fulvic acids, humic acids, and humin respectively (Table 22, p.72). Volatilized  $^{14}\text{CO}_2$  was insignificant totaling  $\leq 1.1\%$  of the applied radioactivity at the final interval (120 days). Based on first-order linear regression analysis (Excel 2000), the half-life is 41.0 days.

### III. STUDY DEFICIENCIES:

### IV. REVIEWER'S COMMENTS:

1. The half-lives calculated from regression analysis for the Arkansas silt loam, California clay loam, and North Dakota loam (33.8, 57.3, 117.5 days, respectively) were significantly longer than the observed half lives of 7-14 days, 7-14 days, and 30-60 days, respectively. Visual inspection of the data indicates that the degradation rate of penoxsulam changed over time, and degradation may be bi-phasic.
2. In the California clay loam soil and North Dakota loam soil, there appeared to be a slight decline in the material balances. In the California clay loam soil, material balance declined from an average 99.5-100.9% of the applied at 0-1 day to 89.2-92.6% at 270-365 days (Table 8, p.58). In the North Dakota loam soil, material balances declined from an average 100.8-101.3% of the applied at 0-1 day to 86.9-102.1% at 91-365 days (Table 9, p.59).
3. A single treated soil dish for each soil type and label were collected at each sampling interval in this study. Replicate (duplicate) sampling at each sampling interval is preferred, so that normal variability can be quantified and outliers identified.
4. It is unclear whether aerobicity was maintained in the flasks. The flasks were attached to an oxygen manifold. However, no flow rate was provided (p.26, Figure 2, p.85). No determinations such as redox potentials were made to verify that aerobic conditions were maintained during the 365 day study.
5. The study author noted that the high  $^{14}\text{CO}_2$  concentration (16.1% of the applied) in the [TP-2- $^{14}\text{C}$ ]penoxsulam treated Arkansas silt loam soil was due to degradation of the entire triazolopyrimidine ring (p.41).
6. The flasks had side traps containing 0.2N NaOH for the collection of volatile components (p.26). The study author reported the volatiles as  $\text{CO}_2$ , however, no method such as barium chloride precipitation was used to confirm the identity of  $^{14}\text{CO}_2$ .
7. The study author noted that the application solution was made up using water, therefore, the soil moisture was not adjusted during the study period (pp.26, 28). The initial soil moisture for the three US soils used in the definitive test was 75% of 1/3 bar.

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8. The study author stated that HPLC analysis was conducted within one week of sampling (pp.28-29). Organic extracts were reported to be stored overnight at 6°C. Samples were analyzed shortly after extraction. Therefore, demonstration of storage stability was not necessary (Table 3, p.53).
9. The study author reported that the maximum application rate for penoxsulam was anticipated to be between 15 and 50 g a.i./ha, assuming 15-cm incorporation and an average bulk density of 1.33 g/cm<sup>3</sup> (p.22). The treatment rate for the aerobic soil metabolism study was 0.075 mg a.i./kg (150 g a.i./ha), or three times the maximum seasonal application rate (50 g a.i./ha) in order to provide detectable quantities of penoxsulam transformation products.
10. Soil microbial viability was measured by dosing the untreated samples with [<sup>14</sup>C-] 3,4-dichlorobenzoic acid (DCBA, radiopurity 98.5%; p.24; Figure 1, p.84). The 365 and 120 day Japanese viability samples were dosed at day 0 with non-radiolabeled penoxsulam (0.102 mg a.i./kg), then treated with <sup>14</sup>C-DCBA (0.1 mg/kg; p.25). After incubation at 25 ± 1°C for 7 days, a portion of the trapping solution was collected and an aliquot analyzed by LSC. The amount of <sup>14</sup>C-DCBA to <sup>14</sup>CO<sub>2</sub> to give a relative measure of the biological activity of the test systems. Soil microbial activity was measured at -11, 39, 91, 179, 270 and 365 days posttreatment for the US soils and -1, 43, 90 and 120 days posttreatment for the Japanese soils.

The study author reported that while the California clay loam (and the two Japanese soils) exhibited similar levels of biological activity throughout the study, the activity of the test system decreased in the Arkansas silt loam by 41-59% (between 39 and 179-365 days posttreatment; p.39-40; Table 5, p.55). The study author concluded that this decreased biological activity did not affect the rate of penoxsulam degradation because 80% of the penoxsulam had degraded by 30 days posttreatment. However, the biological activity of the North Dakota loam decreased to ≤ 16% during the 365 day incubation period and potentially contributed to relatively slow degradation rates of penoxsulam compared to the other soils. The study author postulated that an additional drying step in the preparation of the North Dakota soil, which was excessively wet prior to weighing, may have "...caused the loss of microbial activity...". However, data to adequately support that postulation are not available.

11. The study author also reported that soil degradation rate and equilibrium constants from the one-compartment model in Tables 24-26, pp.74-76.
12. In an anaerobic aquatic metabolism study (MRID 45830725) submitted concurrently with this study, the authors of that study reported that transformation products BSTCA-methyl and 5,8-diOH degraded after 2-3 days even in frozen storage. However, quantitative storage stability results were not provided for penoxsulam and its transformation products.

A soil storage stability study (MRID 45830718) submitted concurrently, indicated that penoxsulam did not significantly degrade after 327 days of frozen storage (average recovery 97.3%), nor was there significant degradation of the transformation products, 5-OH, sulfonamide,

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BSA and 2-amino-TP. However, BSTCA did degrade from an average of 88.7% of the applied at day 0 to 76.7% at 327 days (Tables 2-7, pp.26-31 in MRID 45830718).

### V. REFERENCES:

1. U.S. Environmental Protection Agency. 1982. Pesticide Assessment Guidelines, Subdivision N, Chemistry: Environmental Fate, Section 162-1. Aerobic soil metabolism. Office of Pesticide and Toxic Substances, Washington, DC. EPA 540/9-82-021.
2. 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.
3. 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.

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Attachment 1  
Excel Spreadsheets

Chemical: Penoxsulam  
 MRID: 45830724  
 PC: 119031

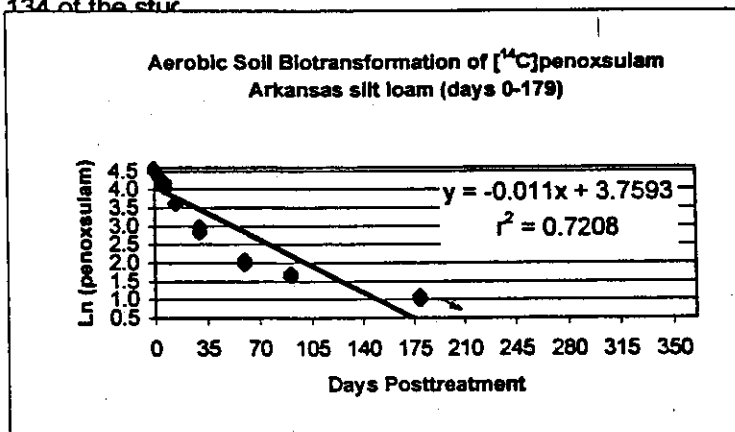
Arkansas silt loam Both labels  
 Half-life (days) 33.80

Days Posttreatment	[ <sup>14</sup> C]Penoxsulam (%applied)	[ <sup>14</sup> C]penoxsulam
0	100.5	4.610
0	96.4	4.569
1	88.8	4.486
1	88.8	4.486
3	76.0	4.331
3	76.6	4.339
7	64.9	4.173
7	57.4	4.050
14	36.5	3.597
14	37.4	3.622
30	16.8	2.821
30	19.5	2.970
60	7.1	1.960
60	7.9	2.067
91	5.1	1.629
91	5.5	1.705
179	2.7	0.993
179	3.0	1.099
365	1.9	0.642
365	1.7	0.531

Data obtained from Appendix C, p. 134 of the study

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.914656
R Square	0.8365957
Adjusted R Square	0.8263829
Standard Error	0.5419225
Observations	18



ANOVA

	df	SS	MS	F
Regression	1	24.05727036	24.0573	81.91663
Residual	16	4.698879187	0.29368	
Total	17	28.75614954		

	Coefficients	Standard Error	t Stat	P-value	Lower 80.0%	Upper 80.0%
Intercept	4.0720216	0.160338576	25.3964	2.34E-14	3.85768782	4.28635529
X Variable 1	-0.020505	0.002265592	-9.0508	1.08E-07	-0.0235339	-0.0174768
time 1/2 =	33.803188 days				29.4531047	39.6609162

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Chemical: Penoxsulam

MRID: 45830724

PC: 119031

California clay loam

Both labels

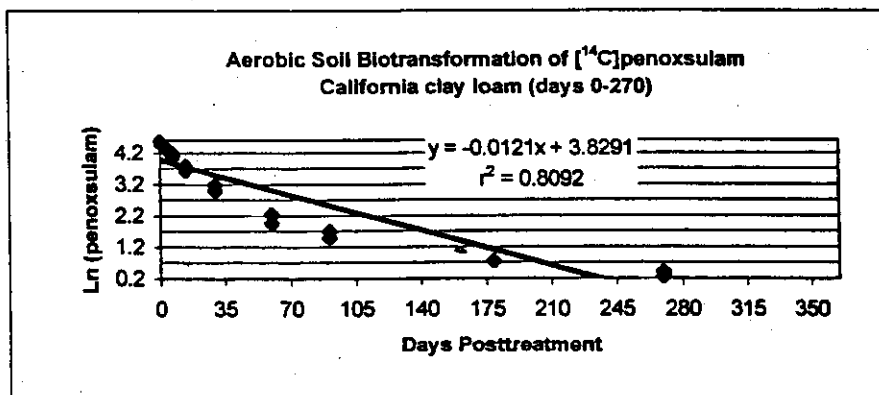
Half-life (days) 43.41

Days Posttreatment	<sup>14</sup> C]Penoxsulam (%applied)	Ln [ <sup>14</sup> C]penoxsulam
0	100.8	4.613
0	95.6	4.560
1	89.5	4.494
1	86.8	4.464
3	78.1	4.358
3	75.7	4.327
7	57.6	4.054
7	64.4	4.165
14	37.6	3.627
14	43.0	3.761
30	20.0	2.996
30	24.1	3.182
60	7.0	1.946
60	9.4	2.241
91	4.4	1.482
91	5.4	1.686
179	2.1	0.742
270	1.5	0.405
270	1.3	0.262
365	1.3	0.262
365	1.4	0.336

Data obtained from Appendix C, p. 135 of the study report

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.91569771
R Square	0.83850229
Adjusted R Square	0.82900242
Standard Error	0.62808321
Observations	19



ANOVA

	df	SS	MS	F
Regression	1	34.81939088	34.81939	88.264651
Residual	17	6.706304741	0.394489	
Total	18	41.52569562		

	Coefficients	Standard Error	t Stat	P-value	Lower 80.0%	Upper 80.0%
Intercept	3.96962826	0.17605785	22.54729	4.183E-14	3.734876331	4.204380182
X Variable 1	-0.01596626	0.001699455	-9.39493	3.834E-08	-0.01823228	-0.01370024
time 1/2 =	43.4132522 days				38.01758782	50.59380165

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Chemical: Penoxsulam  
 MRID: 45830724  
 PC: 119031

North Dakota loam Both labels  
 Half-life (days) 117.48

Days Posttreatment	[ <sup>14</sup> C]Penoxsulam (%applied)	Ln [ <sup>14</sup> C]penoxsulam
0	101.00	4.615
0	96.40	4.569
1	92.40	4.526
1	87.90	4.476
3	84.40	4.436
3	78.80	4.367
7	66.50	4.197
7	77.40	4.349
14	69.30	4.238
14	67.10	4.206
30	54.20	3.993
30	57.90	4.059
60	38.60	3.653
60	40.60	3.704
91	29.90	3.398
91	31.70	3.456
179	21.70	3.077
179	20.60	3.025
270	13.20	2.580
270	16.80	2.821
365	10.30	2.332
365	11.10	2.407

Data obtained from Appendix C, p. 136 of 1

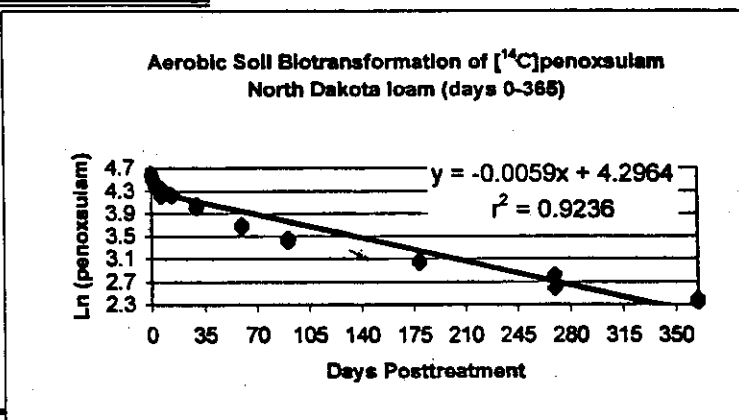
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.961061239
R Square	0.923638706
Adjusted R Square	0.919820641
Standard Error	0.212281246
Observations	22

ANOVA

	df	SS	MS	F
Regression	1	10.90139546	10.9014	241.9
Residual	20	0.901266546	0.04506	
Total	21	11.80266201		

	Coefficients	Standard Error	t Stat	P-value	Lower 80.0%	Upper 80.0%
Intercept	4.296352395	0.057317597	74.957	6E-26	4.22038705	4.372317738
X Variable 1	-0.005899323	0.000379291	-15.5535	1E-12	-0.006402	-0.00539663
time 1/2 =	117.4960519 days					



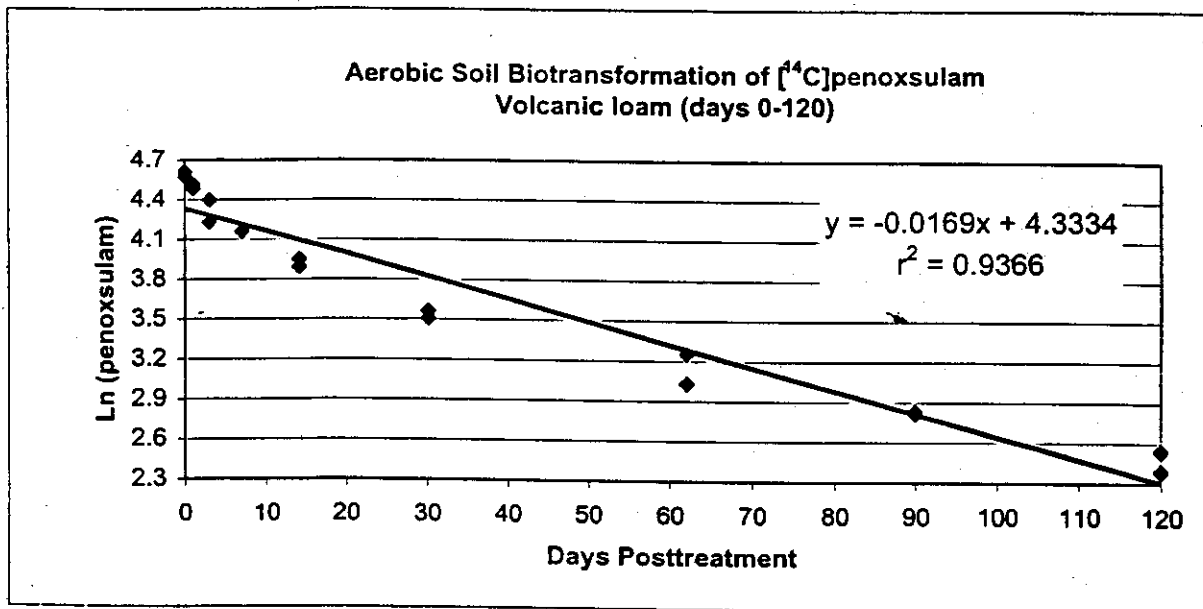
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Chemical: Penoxsulam  
MRID: 45830724  
PC: 119031

Japanese Non-Volcanic  
Half-life (days) 41.01  
Both labels

Days Posttreatment	[ <sup>14</sup> C]Penoxsulam (%applied)	Ln [ <sup>14</sup> C]penoxsulam
0	96.9	4.574
0	100.5	4.610
1	91.3	4.514
1	88.7	4.485
3	68.6	4.228
3	81.1	4.396
7	63.9	4.157
14	49.1	3.894
14	51.9	3.949
30	33.3	3.506
30	35.2	3.561
62	20.7	3.030
62	25.9	3.254
90	16.6	2.809
90	17.0	2.833
120	12.7	2.542
120	10.9	2.389

Data obtained from Appendix C, p. 138 of the study report.



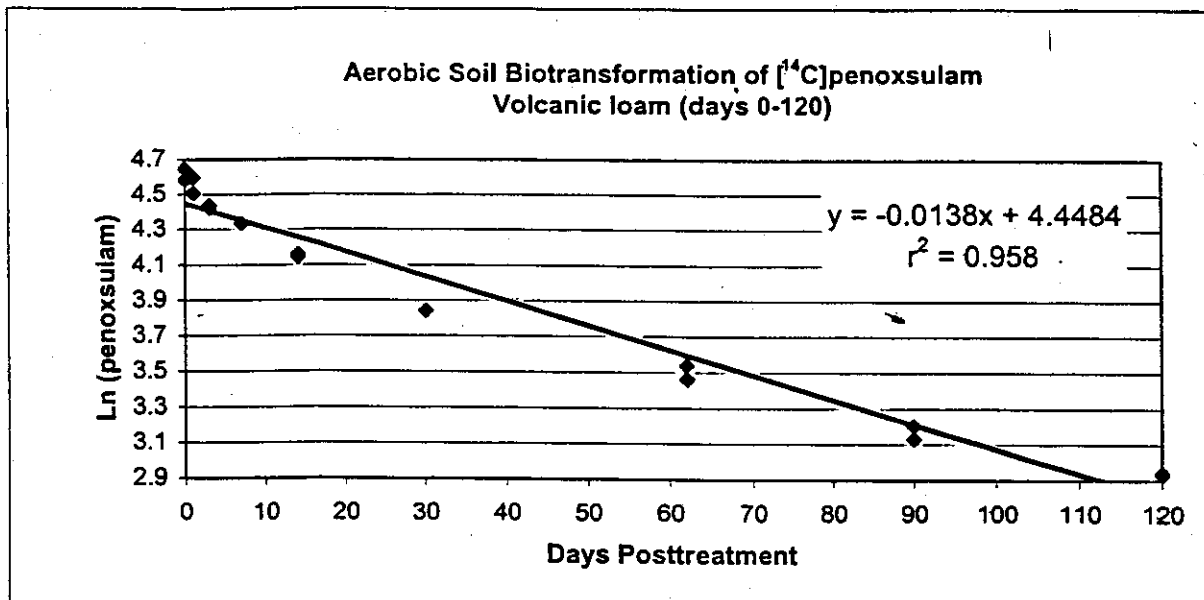
34

Chemical: Penoxsulam  
MRID: 45830724  
PC: 119031

Japanese Volcanic  
Half-life (days) 50.23  
Both Labels

Days Posttreatment	[ <sup>14</sup> C]Penoxsulam (%applied)	Ln [ <sup>14</sup> C]penoxsulam
0	97.8	4.583
0	103.9	4.643
1	99.2	4.597
1	90.6	4.506
3	84.6	4.438
3	83.1	4.420
7	76.2	4.333
14	64.0	4.159
14	63.1	4.145
30	46.6	3.842
30	46.6	3.842
62	31.9	3.463
62	34.4	3.538
90	22.9	3.131
90	24.6	3.203
120	18.9	2.939
120	18.8	2.934

Data obtained from Appendix C, p. 137 of the study report.



Chemical: Penoxsulam  
MRID: 45830724  
PC: 119031

Arkansas silt loam

Material Balances Data from Table 7, p. 57 of the study report.

Both labels		TP label	Phenyl	
0	104	0	104	98.8
0	98.8	1	101.1	99.1
1	101.1	3	101.4	98.4
1	99.1	7	99.8	97.8
3	101.4	14	103.6	98.2
3	98.4	30	102.5	96.6
7	99.8	60	102.6	96.9
7	97.8	90	98.2	96.9
14	103.6	179	100.8	97.5
14	98.2	365	98.4	98.9
30	102.5	Average	101.24	97.91
30	96.6	SD	2.01	0.91
60	102.6			
60	96.9			
91	98.2			
91	96.9			
179	100.8			
179	97.5			
365	98.4			
365	98.9			
Average	99.58			
SD	2.28			

Chemical: Penoxsulam  
MRID: 45830724  
PC: 119031

California

Material Balance Data from Table 8, p. 58 of the study report.

Both labels		TP label	Phenyl	
0	103.2	0	103.2	98.5
0	98.5	1	100.7	98.4
1	100.7	3	101.4	94.9
1	98.4	7	95.5	97.7
3	101.4	14	100.1	95
3	94.9	30	93.4	93.9
7	95.5	60	92.5	91.3
7	97.7	90	94.1	92.5
14	100.1	179	100.7	
14	95	270	96.3	88.8
30	93.4	365	88.3	90.2
30	93.9	Average	96.93	94.12
60	92.5	SD	4.63	3.43
60	91.3			
91	94.1			
91	92.5			
179	100.7			
179				
270	96.3			
270	88.8			
365	88.3			
365	90.2			
Average	95.59			
SD	4.25			

Chemical: Penoxsulam  
MRID: 45830724  
PC: 119031

North Dakota

Material Balance

Data from Table 9, p. 59 of the study report.

Both labels

TP label    Phenyl

0	103.8	0	103.8	98.8
0	98.8	1	103.7	97.9
1	103.7	3	101.4	93.3
1	97.9	7	101.7	100.1
3	101.4	14	101.1	97.5
3	93.3	30	93.8	94.7
7	101.7	60	95.4	94.7
7	100.1	90	86.8	88.3
14	101.1	179	87.1	90.7
14	97.5	270	90.9	113.2
30	93.8	365	88.8	85
30	94.7	Average	95.86	95.84
60	95.4	SD	6.74	7.38
60	94.7			
91	86.8			
91	88.3			
179	87.1			
179	90.7			
270	90.9			
270	113.2			
365	88.8			
365	85			
Average	95.85			
SD	6.90			

Attachment 2

Structures of Parent and Transformation Products



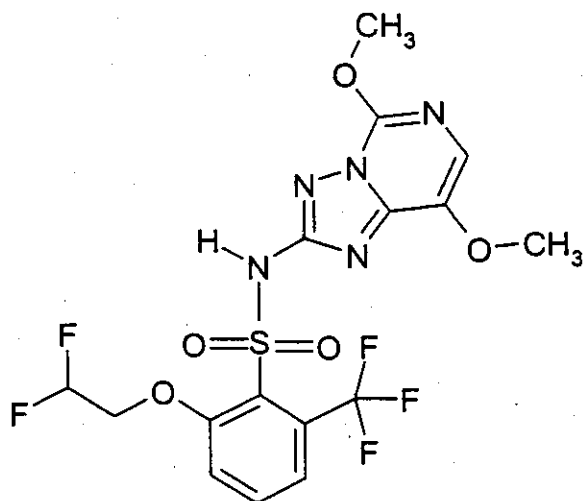
**Penoxsulam**

**IUPAC name:** 3-(2,2-Difluoroethoxy)-N-(5,8-dimethoxy[1,2,4]triazolo[1,5-c]pyrimidin-2-yl)- $\alpha,\alpha,\alpha$ -trifluorotoluene-2-sulfonamide

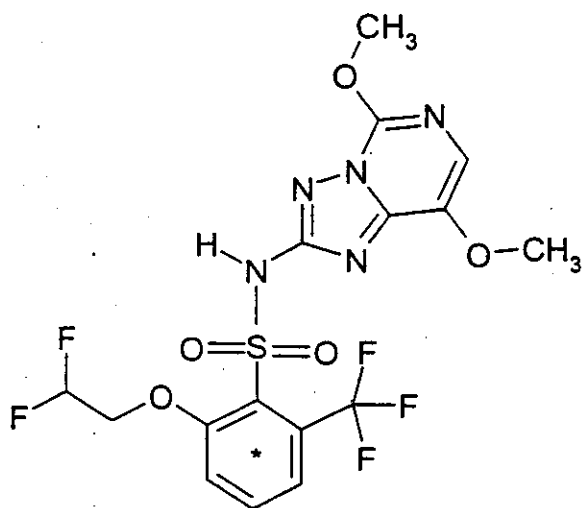
**CAS name:** 2-(2,2-Difluoroethoxy)-N-(5,8-dimethoxy[1,2,4]triazolo[1,5-c]pyrimidin-2-yl)-6-(trifluoromethyl)benzenesulfonamide

**CAS No:** 219714-96-2

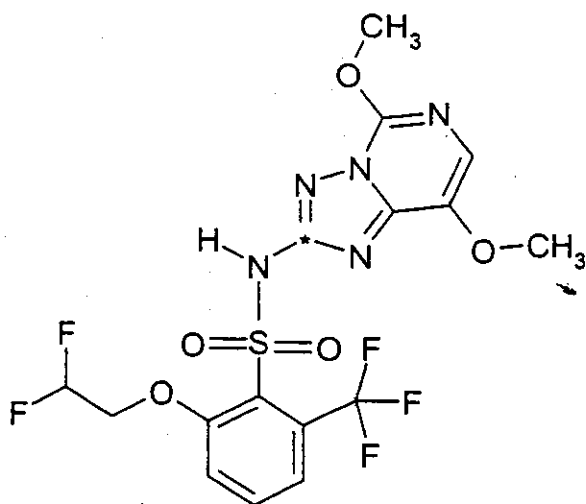
**Unlabeled**



[Phenyl-U-<sup>14</sup>C] label



[Triazolopyrimidine-2-<sup>14</sup>C] label



\* Position of the radiolabel.

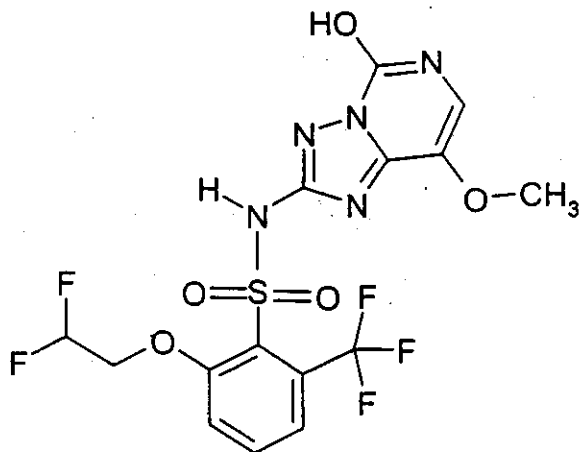
5-OH-XDE-638

IUPAC name: 6-(2,2-Difluoroethoxy)-N-(5,6-dihydro-8-methoxy-5-oxo-s-triazolo[1,5-c]pyrimidin-2-yl)- $\alpha,\alpha,\alpha$ -trifluoro-o-toluenesulfonamide

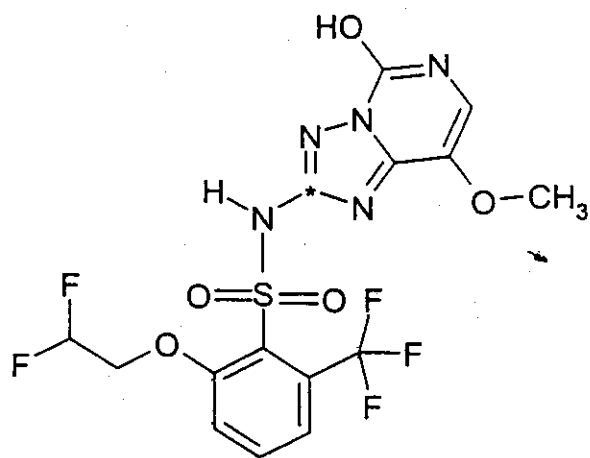
CAS name: 2-(2,2-Difluoroethoxy)-N-(5,6-dihydro-8-methoxy-5-oxo[1,2,4]triazolo[1,5-c]pyrimidin-2-yl)-6-(trifluoromethyl)benzenesulfonamide

CAS No: NA

Unlabeled



[Triazolopyrimidine-2-<sup>14</sup>C] label



\* Position of the radiolabel.

43

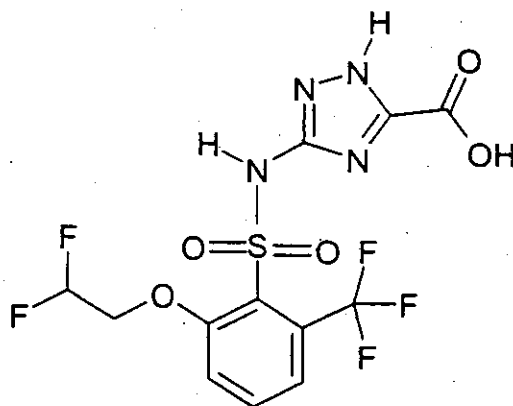
BSTCA

IUPAC name: 3-[6-(2,2-Difluoroethoxy)- $\alpha,\alpha,\alpha$ -(trifluoro-*o*-toluenesulfonamido)]-s-triazole-5-carboxylic acid

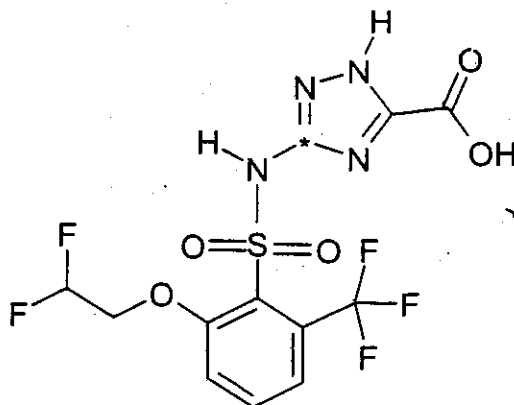
CAS name: 3-[[[2-(2,2-Difluoroethoxy)-6-(trifluoromethyl)phenyl]-sulfonyl]amino]-1H-1,2,4-triazole-5-carboxylic acid

CAS No: NA

Unlabeled



[Triazolopyrimidine-2-<sup>14</sup>C] label



\* Position of the radiolabel.

44

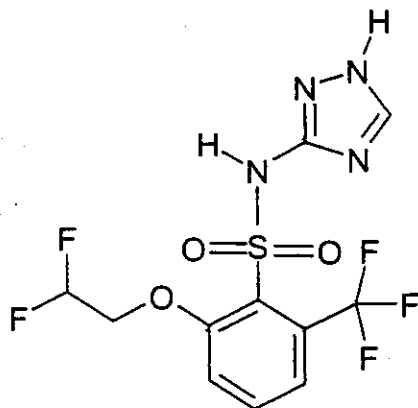
BST

IUPAC name: 6-(2,2-Difluoroethoxy)- $\alpha,\alpha,\alpha$ -trifluoro-N-s-triazol-3-yl-o-toluenesulfonamide

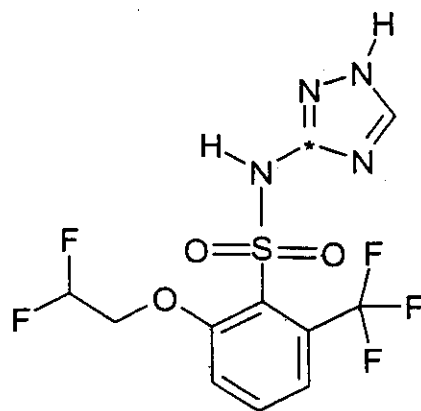
CAS name: 2-(2,2-Difluoroethoxy)-N-1H-1,2,4-triazole-3-yl-6-(trifluoromethyl)benzenesulfonamide

CAS No: NA

Unlabeled



[Triazolopyrimidine-2-<sup>14</sup>C] label

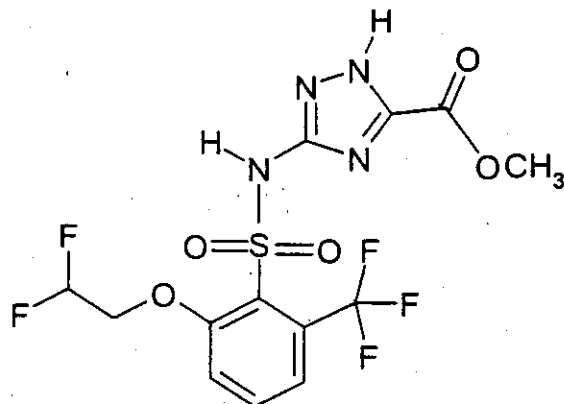


\* Position of the radiolabel.

45

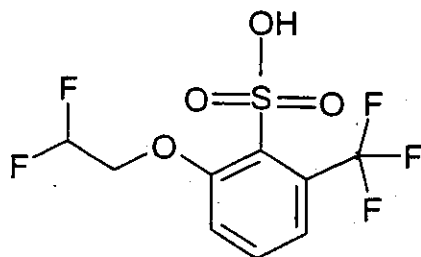
**BSTCA-methyl**

**IUPAC name:** Methyl 3-[6-(2,2-difluoroethoxy)- $\alpha,\alpha,\alpha$ -trifluoro-*o*-toluenesulfonamido]-s-triazole-5-carboxylate  
**CAS name:** Methyl 3-[[[2-(2,2-difluoroethoxy)-6-(trifluoromethyl)phenyl]sulfonyl]amino]-1H-1,2,4-triazole-5-carboxylate  
**CAS No:** NA



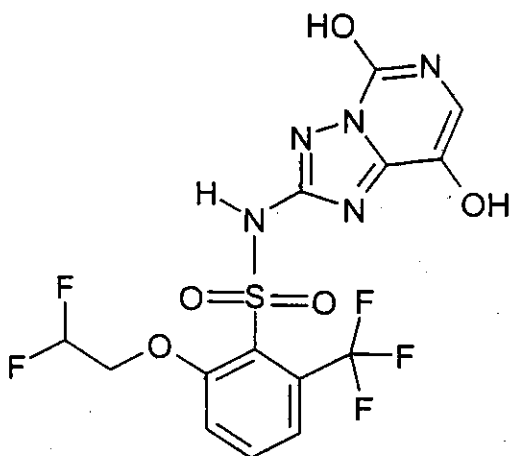
**BSA**

**IUPAC name:** 6-(2,2-Difluoroethoxy)- $\alpha,\alpha,\alpha$ -trifluoro-*o*-toluenesulfonic acid  
**CAS name:** 2-(2,2-Difluoroethoxy)-6-(trifluoromethyl)benzenesulfonic acid  
**CAS No:** NA



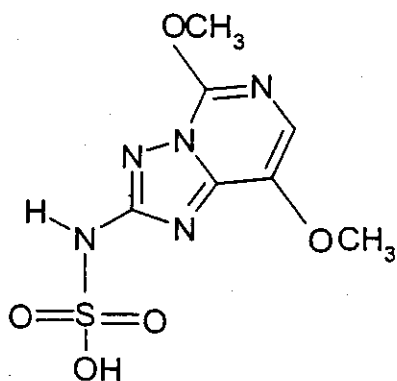
5,8-diOH

IUPAC name: NA  
CAS name: 2-(2,2-Difluoroethoxy)-6-trifluoromethyl-N-(5,8-dihydroxy-  
[1,2,4]triazolo[1,5-c]pyrimidin-2-yl)benzenesulfonamide  
CAS No: NA



TPSA

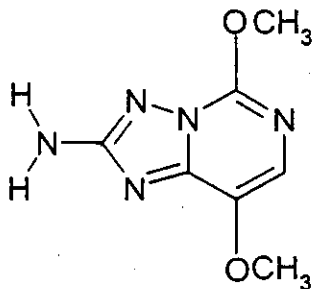
IUPAC name: NA  
CAS name: 5,8-Dimethoxy[1,2,4]triazolo-[1,5-c]pyrimidin-2-yl-sulfamic acid  
CAS No: NA



47

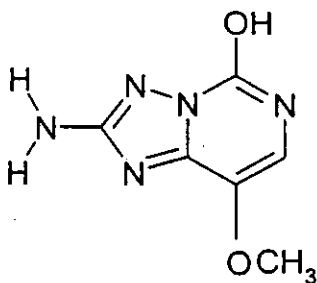
**2-Amino TP**

**IUPAC name:** 2-Amino-5,8-dimethoxy-s-triazolo[1,5-c]pyrimidine  
**CAS name:** 5,8-Dimethoxy[1,2,4]triazolo[1,5-c]pyrimidin-2-amine  
**CAS No:** NA



**5-OH, 2-Amino TP**

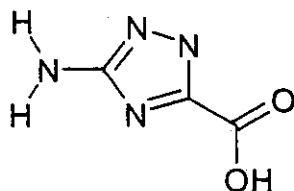
**IUPAC name:** NA  
**CAS name:** 8-Methoxy[1,2,4]triazolo-[1,5-c]pyrimidin-5-ol-2-amine  
**CAS No:** NA





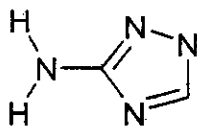
## 2-Amino TCA

IUPAC name: NA  
CAS name: 2-Amino-1,3,4-triazole-5-carboxylic acid  
CAS No: NA



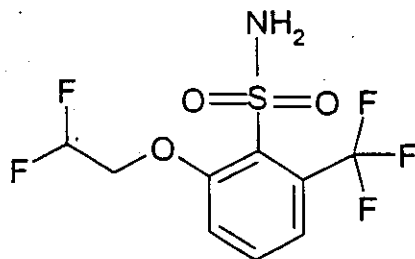
## 2-Amino-1,3,4-triazole

IUPAC name: NA  
CAS name: 2-Amino-1,3,4-triazole  
CAS No: NA



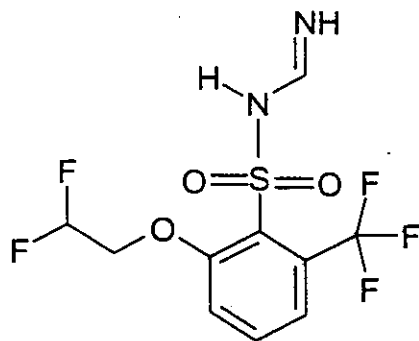
## Sulfonamide

IUPAC name: 2-(2,2-Difluoroethoxy)-6-(trifluoromethyl)-benzenesulfonamide  
CAS name: 2-(2,2-Difluoroethoxy)-6-(trifluoromethyl)-benzenesulfonamide  
CAS No: NA



## Sulfonylformamidine

IUPAC name: 2-(2,2-Difluoroethoxy)-N-[(E)iminomethyl]-6-(trifluoromethyl)benzenesulfonamide  
CAS name: 2-(2,2-Difluoroethoxy)-N-(iminomethyl)-6-(trifluoromethyl)-benzenesulfonamide  
CAS No: NA



Attachment 3

Transformation Pathway Presented by Registrant  
Illustration of Test System

NER FOR

MRI D #'S 45830724

Page      is not included in this copy.

Pages 52 through 53 are not included.

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