Data Evaluation Report on the aerobic biotransformation of BAS 510 F in soil

PMRA Submission Number {.....} EPA MRID Number 45405210

Data Requirement: PMRA Data Code:
EPA DP Barcode: D278387
OECD Data Point:
EPA Guideline: 162-1

Test material:
Common name: BAS 510 F
Chemical name
IUPAC: 2-Chloro-*N*-(4-chlorobiphenyl-2-yl)-nicotinamide.
CAS name: 2-Chloro-*N*-(4-chloro[1,1-biphenyl]-2-yl)-3-pyridinecarboxamide.
CAS No: 188425-85-6.
Synonyms: 2-Chloro-*N*-(4'-chlorobiphenyl-2-yl)-nicotinamide.
Nicobifen.
~~BAS 516 02 F~~.
SMILES string:

Primary Reviewer: Joan Gaidos
Dynamac Corporation

Signature: Jo. Gs
Date: 01/16/02

QC Reviewer: Kathleen Ferguson
Dynamac Corporation

Signature: Kathleen Ferguson
Date: 1/21/02

Secondary Reviewer: Cheryl Sutton
EPA

Signature: Cheryl Sutton
Date: 11/02

Company Code: [for PMRA]
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CITATION: Paulick, R.C. and M. Baucom. 2001. Aerobic soil metabolism of ^{14}C-BAS 510 F. Unpublished study performed by BASF Corporation, BASF Agro Research, Research Triangle Park, NC and AgVise Laboratories, Northwood, ND. Submitted by BASF Corporation, Research Triangle Park, NC. Laboratory Project Identification: BASF Protocol No. 64052; BASF Registration Document No. 2001/5001022. Study initiated July 11, 2000, and completed March 27, 2001 (p. 11).

EXECUTIVE SUMMARY:

The biotransformation of radiolabeled [pyridine-3-^{14}C]2-chloro-*N*-(4-chlorobiphenyl-2-yl)-nicotinamide (BAS 510 F) was studied in a California clay loam soil (pH 7.8, organic matter 4.6%), an Idaho clay loam soil (pH 6.8, organic matter 3.4%), an Illinois silt loam soil (pH 6.5, organic matter 2.3%), and a North Dakota loam (pH 7.7, organic matter 3.6%) for 127 days under aerobic conditions in darkness at 27°C with a soil moisture content of 75% of field capacity at 1/3 bar. [^{14}C]BAS 510 F was applied at a nominal rate of 0.825 mg a.i./kg (reported to be equivalent to 0.937 kg a.i./ha for all soil types). The experiment was conducted in accordance with USEPA Subdivision N Guideline §162-1 and PMRA Guideline T-1-255, DACO 8.2.3.4.2. and in compliance with the 40 CFR Part 160 GLP standards. The test system consisted dishes of treated soil that were contained in glass metabolism towers (not described); at each sampling interval, the air in the towers was evacuated through a 1 N NaOH trapping solution. Duplicate samples of each soil were collected after 0, 7, 14, 29, 63, 91, and 127 days of incubation. Single samples were analyzed at all intervals except 0, 29, and 127 days. The soil samples were sequentially extracted 2 to 3 times with methanol and 1 to 3 times with methanol and water (1:1, v:v). Extracts and extracted soil were analyzed for total radioactivity using LSC. [^{14}C]BAS 510 F and its transformation products were separated by HPLC and identified by comparison to reference standards.

Overall recoveries of radiolabeled material averaged 103.6 ± 4.96% of the applied in the four soils during 127 days of incubation. There was no pattern of decline in any soil; in all soils, the concentration of total [^{14}C]residues at 127 days posttreatment was higher than at 0 day. The half-lives of [^{14}C]BAS 510 F were estimated to be 173-178 days in the North Dakota loam and California clay loam soils, 239 days in the Illinois silt loam soil, and 433 days in the Idaho clay loam soil. The rate of degradation appeared to be unrelated to microbial biomass, clay content, organic matter content, CEC, or pH. Volatilized $^{14}CO_2$ was the only major transformation product, and soil bound residues were relatively high, at a range of 17.8-40.4%, in all four soils. One minor transformation product was M510F49 [2-hydroxy-N-(4'-chlorobiphenyl-2-yl)-nicotinamide; BAS Number 391572].

In the California clay loam soil, mean [^{14}C]BAS 510 F decreased from 93.0% of the applied radioactivity at day 0 to 54.5 % at 127 days; the half-life was estimated to be 178 days (r^2 = 0.9443). "Other" extractable [^{14}C]residues, consisting primarily or only of 2-hydroxy-N-(4'-chlorobiphenyl-2-yl)-nicotinamide (BAS No. 391572), were a maximum 1.3% of the applied at 0 and 63 days posttreatment. Extractable [^{14}C]residues decreased from 94.3 ± 1.20% of the applied at day 0 to 55.3 ± 1.48% at 127 days, and nonextractable [^{14}C] residues increased from 2.2 ± 0.14% to 32.3 ± 4.17%. Volatile [^{14}C]residues (most likely CO_2) totaled 14.2 ± 1.97% of the applied at 127 days posttreatment.

In the Idaho clay loam soil, mean [^{14}C]BAS 510 F decreased from 93.6 % of applied radioactivity at day 0 to 76.5 % at 127 days; the half-life was estimated to be 433 days (r^2 = 0.8490). "Other" extractable [^{14}C]residues, consisting primarily or only of 2-hydroxy-N-(4'-chlorobiphenyl-2-yl)-nicotinamide, were a maximum 4.7% of the applied at 63 days posttreatment. Extractable

[^{14}C]residues decreased from 95.1 ± 0.92% at day 0 to 79.6 ± 1.41% at 127 days, and nonextractable [^{14}C]residues increased from 1.3 ± 0.00% to 17.8 ± 0.28%. Volatile [^{14}C]residues (most likely CO_2) totaled 11.5 ± 0.54% of the applied at 127 days posttreatment.

In the Illinois silt loam soil, mean [^{14}C]BAS 510 F decreased from 93.6 % of the applied radioactivity at day 0 to 67.7 % at 127 days; the half-life was estimated to be 239 days (r^2 = 0.8114). "Other" extractable [^{14}C]residues, consisting primarily or only of 2-hydroxy-N-(4'-chlorobiphenyl-2-yl)-nicotinamide, were a maximum 14.0% of the applied at 63 days posttreatment, decreasing to 10.1% at 127 days. Extractable [^{14}C]residues decreased from 95.2 ± 3.39% at day 0 to 77.8 ± 0.41% at 127 days, and nonextractable [^{14}C]residues increased from 1.6 ± 0.78% to 21.7 ± 0.14%. Volatile [^{14}C]residues (most likely CO_2) totaled 5.6 ± 0.89% of the applied at 127 days posttreatment.

In the North Dakota loam soil, mean [^{14}C]BAS 510 F decreased from 96.2 % of the applied at day 0 to 54.0 % at 127 days; the half-life was estimated to be 173 days (r^2 = 0.8766). "Other" extractable [^{14}C]residues, consisting primarily or only of 2-hydroxy-N-(4'-chlorobiphenyl-2-yl)-nicotinamide, were a maximum 3.8% of the applied at 63 days posttreatment. Extractable [^{14}C] residues decreased from 98.1 ± 2.33% at day 0 to 57.0 ± 0.14% at 127 days, and nonextractable [^{14}C]residues increased from 2.1 ± 0.28% to 40.4 ± 1.48%. Volatile [^{14}C]residues (most likely CO_2) totaled 8.0 ± 1.11% of the applied at 127 days posttreatment.

A biotransformation pathway was not proposed by the registrant. In MRID 45405208, it was proposed that BAS 510 F degrades to M510F49 and/or M510F50 (Unknown 2). The parent and these transformation products are degraded to CO_2 and are converted to soil bound residues.

Results Synopsis:

Soil type: California clay loam
Half-life/DT_{50}: *ca.* 178 days (based only on data through 127 days, and affected by a high level of bound residues)
Major transformation products: CO_2
Minor transformation products: 2-hydroxy-N-(4'-chlorobiphenyl-2-yl)-nicotinamide.

Soil type: Idaho clay loam
Half-life/DT_{50}: *ca.* 433 days (based only on data through 127 days, and affected by a high level of bound residues)
Major transformation products: CO_2
Minor transformation products: 2-hydroxy-N-(4'-chlorobiphenyl-2-yl)-nicotinamide.

Soil type: Illinois silt loam
Half-life/DT_{50}: *ca.* 239 days (based only on data through 127 days, and affected by a high level of bound residues)
Major transformation products: CO_2
Minor transformation products: 2-hydroxy-N-(4'-chlorobiphenyl-2-yl)-nicotinamide.

Soil type: North Dakota loam
Half-life/DT_{50}: *ca.* 173 days (based only on data through 127 days, and affected by a high level of bound residues)
Major transformation products: CO_2
Minor transformation products: 2-hydroxy-N-(4'-chlorobiphenyl-2-yl)-nicotinamide.

Study Acceptability: This study is classified as not acceptable. The study is not scientifically valid with regard to the determination of the half-lives, as they were determined by extrapolating beyond the range of the data. It cannot be used to satisfy Subdivision N Guidelines (§161-2) because the study was terminated after only 127 days, before the half-life was reached in any of the soils, and prior to one year (as required by Subdivision N Guidelines). However, the study author stated that this submission is intended to be an interim report, and that soil samples will be collected up to 360 days posttreatment (p. 19). It is also noted that replicate data were not obtained for all sampling intervals, as necessary for a quantitative determination of data variability.

I. MATERIALS AND METHODS

GUIDELINE FOLLOWED: This study was conducted in accordance with the USEPA Subdivision N Guideline §162-1 and PMRA Guideline T-1-255, DACO 8.2.3.4.2. A significant deviation from USEPA Subdivision N Guideline §162-1 was:

> The study was terminated at 127 days posttreatment, before 54-76% of the applied BAS 510 F had degraded. This does not affect the scientific validity of the experimental design of the study, but does not allow for the valid determination of half-lives. The study author described this as an interim report, and stated that samples would be collected through 360 days posttreatment (p. 19).

COMPLIANCE: This study was conducted in compliance with USEPA GLP Standards (40 CFR Part 160, 1989; p. 3). Signed and dated Data Confidentiality, GLP, Quality Assurance and certification of authenticity statements were provided (pp. 2-5).

A. MATERIALS:

1. Test Material [Pyridine-3-^{14}C]-labeled BAS 510 F.

Chemical Structure:

Description: Solid (p. 14).

Purity: Radiochemical purity: >99% (p.12)
Analytical purity: >97%
Batch No. 640-2037
Specific activity: 310,000 dpm/µg
Location of the radiolabel: Carbon 3 of pyridine ring

Storage conditions of test chemicals: Storage conditions were not reported.

Table 1. Physico-chemical properties of BAS 510 F.

Parameter	Values	Comments
Molecular weight	343.2 g/mol	
Water solubility	4.64 mg/L at 20°C	
Vapor pressure/volatility	Not reported.	
UV absorption	Not reported.	
pK_a	Not reported.	
K_{ow}/log K_{ow}	Not reported.	
Stability at room temperature	Not reported.	

Data obtained from pp.13 and 20 of the study report.

2. Soil Characteristics

Table 2: Description of soil collection and storage.

Description	California	Idaho	Illinois	North Dakota
Geographic location	Santa Maria, California	Payette, Idaho	Carlyle, Illinois	Gardner, North Dakota
Collection Date	Not reported. Soils received at the lab between May 11, 2000 and June 29, 2000.			
Pesticide use history at the collection site	Not reported.			
Collection procedures	Not reported.			
Sampling depth (cm)	0-6 inches. (p. 40-51)			
Storage conditions	Upon receipt, soil samples were refrigerated until use.			
Storage length	Not reported.			
Soil preparation	Allowed to dry slightly if necessary, then 2-mm sieved			

Data obtained from p. 13 of the study report.

Table 3: Properties of the soils.

Property	California	Idaho	Illinois	North Dakota
Soil texture	Clay loam	Clay loam	Silt loam	Loam
% sand	44	32	28	46
% silt	28	38	54	34
% clay	28	30	18	20
pH (saturated paste)	7.8	6.8	6.5	7.7
Organic carbon (%)	Not reported.			
Organic matter (%)	4.6	3.4	2.3	3.6
CEC (meq/100 g)	23.1	22.0	12.9	22.7
Moisture at 1/3 atm (%)	24.1	35.7	30.2	26.1
Bulk density (g/cm^3)	Not reported.			
Soil Taxonomic classification	Sorrento, fine-loamy, mixed, superactive, thermic Calcic Haploxerolls	Hall, fine-silty, mixed, mesic, Pachic Argiustolls	Cisne, fine, montmorillinitic, mesic Mollic Albaqualfs	Beardon, fine-silty, frigid Aeric Calciaquolls
Soil Mapping Unit (for EPA)	Not reported.			

Data obtained from p. 21 of the study report.

B. EXPERIMENTAL CONDITIONS:

1. Preliminary experiments: Preliminary experiments were not conducted.

2. Experimental conditions:

Table 4: Experimental design.

Parameter		California	Idaho	Illinois	North Dakota
Duration of the test		127 days			
Soil condition (air dried/fresh)		Bulk soils were moistened to 75% of 1/3 bar and allowed to equilibrate in the refrigerator for at least 3 days.			
Soil (g/replicate)		40 g dry wt			
Application rate (measured		0.88 mg/kg; 0.99 kg/ha (p. 24)		0.95 mg/kg; 1.07 kg/ha (p. 24)	
Control conditions, if used		No controls were used.			
No. of Replication	Controls, if used	None			
	Treatments	Duplicate samples were collected at each sampling interval. Only one of the two samples was analyzed at most intervals; the second sample was stored frozen. Both samples collected on days 0, 29, and 127 were analyzed.			
Test apparatus (Type/material/volume)		Soil samples (40 g) were weighed into glass test dishes (not described) and treated with ^{14}C-BAS 510 F. The dishes were then placed into glass metabolism towers and incubated in darkness.			
Details of traps for CO_2 and organic volatile, if any		At each sampling interval, the air in the tower was evacuated through a pair of tubes containing 1N NaOH (volume not reported). Air was drawn through system for at least 60 minutes. No other description of the volatile trapping system was provided.			
If no traps were used, is the system closed/open		Volatile traps were used.			
Co-solvent	Identity	Acetonitrile			
	Final concentration	Approximately 0.4%			
Test material application	Volume of test solution used/treatment	170 µL of 0.20µg a.i./µL test solution per 40 g soil		180 µL of 0.20µg a.i./µL test solution per 40 g soil	
	Application method	Not reported.			
	Is the co-solvent evaporated?	No.			

Parameter		California	Idaho	Illinois	North Dakota
Microbial biomass of the soil Initial		218.9 µg/g	301.5 µg/g	24.3 µg/g	80.1 µg/g
CFU per g dry soil	Actinomycetes	6.04×10^5	4.57×10^5	4.95×10^5	1.62×10^5
	Fungi	3.07×10^3	1.38×10^4	3.47×10^4	1.69×10^4
	Bacteria	2.69×10^6	9.91×10^5	2.86×10^6	4.55×10^6
Microbial biomass/microbial population of treated soil, if provided		Not reported.			
Any indication of the test material adsorbing to the walls of the test apparatus?		Not determined.			
Experimental conditions	Temperature (°C)	27 °C			
	Moisture content Moisture maintenance method:	75% of 1/3 bar Soil moisture maintenance methods were not reported.			
	Continuous darkness (Yes/No):	Yes			
Other details, if any		None			

Data obtained from pp. 13-16, 18, and 21 of the study report.

3. Aerobic conditions: Samples were incubated in glass metabolism towers at 27°C in the dark (pp. 15 and 18). Aerobic conditions were maintained throughout the study by flushing the metabolism towers at each sampling period. No determinations were made, such as redox potentials, to verify that aerobic conditions were maintained

4. Supplementary experiments: No supplemental experiments were conducted.

5. Sampling:

Table 5: Sampling details.

Parameters	Details
Sampling intervals	0, 7, 14, 29, 63, 91 and 127 days
Sampling method for soil samples	Two dishes of each soil were collected at each sampling interval. At most intervals, one sample was analyzed and the other sample frozen.
Method of collection of CO_2 and volatile organic compounds	Gases were evacuated from each tower 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 reported. Not reported.
Sample storage before analysis	Not reported. Primary analysis was conducted within 30 days of sampling (p. 23).
Other observations, if any	None

Data obtained from pp. 14-15.

C. ANALYTICAL METHODS:

Extraction/clean up/concentration methods: Soil samples were extracted sequentially 2-3 times with 100 mL of methanol and 1-3 times with 100 mL of methanol:water (1:1, v:v) by mechanical shaking (300 strokes/minute) for 45 minutes per extraction; the number of extractions increased with the duration of the study (p. 16). Following each extraction, the mixtures were separated by centrifugation. Portions of each extract were analyzed using LSC. The extracts were combined and evaporated to dryness, and the residues were dissolved in methanol:water (1:2, v:v) for HPLC analysis (p. 18).

Nonextractable residue determination: Portions of the extracted soils were analyzed for total radioactivity using LSC following combustion (p. 17).

Volatile residue determination: Aliquots of each trapping solution were analyzed for total radioactivity by LSC (p. 17).

Total ^{14}C measurement: Total ^{14}C residues were determined by summing the concentration of residues measured in the soil extracts, extracted soil, and volatile trapping solutions.

Derivatization method, if used: A derivation method was not employed.

Identification and quantification of parent compound: Extracts were analyzed by HPLC under the following conditions: YMC-Pack ODS-AQ 120 A column (dimensions and particle size not specified); gradient mobile phase combined A) 0.1% formic acid in water and B) 0.1% formic acid in acetonitrile [% A:B at 0 min. 95:5 (v:v), 5 min 95:5, 15 min 45:55, 25 min 35:65, 31 min 5:95, 36 5:95, 40 min 95:5]; flow rate of 1 mL/minute; UV (254 nm) and IN/US radioactivity detection (p. 15). BAS 510 F was identified by comparison to a reference standard.

Identification and quantification of transformation products: Transformation products were separated and quantified as described for the parent. Identification was attempted by comparison to reference standards of 2-(4-chlorophenyl)aniline (BAS No. 363487), 2-hydroxy-N-(4'-chlorobiphenyl-2-yl)-nicotinamide (M510F49; BAS No. 391572), and 2-chloronicotinic acid (BAS No. 107371) (p. 20).

Detection limits (LOD, LOQ) for the parent compound: Limits of detection for LSC were 60 dpm or 0.007% of the applied radioactivity. The limit of detection for the HPLC on-screen quantification was influenced by the dpm injected and the percent applied radioactivity contained in the fraction. The limit of detection was 0.5-1.0% of the applied radioactivity (p. 16).

Detection limits (LOD, LOQ) for the transformation products: Limits of detection were the same as those described for the parent.

II. RESULTS AND DISCUSSION:

A. TEST CONDITIONS: It was reported that aerobicity, moisture, temperature and other environmental conditions were maintained throughout the study. No supporting records were provided.

B. MATERIAL BALANCE: Overall recoveries of radiolabeled material averaged 103.6 ± 4.96% of applied in the four soils during 127 days of incubation (pp. 26-29). There was no pattern of decline in any soil; in all soils, the concentration of residues at 127 days posttreatment was higher than at 0 day. In the California clay loam, total recoveries ranged from 95.5 to 104.7% of the applied. In the Idaho clay loam, total recoveries ranged from 95.7 to 110.5% of applied. In the Illinois silt loam, total recoveries ranged from 93.8 to 113.5% of the applied. In the North Dakota loam, total recoveries ranged from 98.7 to 113.8% of the applied.

Table 6: Biotransformation of [^{14}C]BAS 510 F, expressed as percentage of applied radioactivity (mean ± s.d when n = 2), in **California clay loam** under aerobic conditions.*

Compound	Sampling times (days after treatment)						
	0	7	14	29	63	91	127
BAS 510 F	93.0	85.0	77.7	73.9	65.6	59.7	54.5
"Others"[1]	1.3	1.6	0.9	1.0	1.3	1.0	0.9
Total extractable residues	94.3 ± 1.20	86.6	78.6	74.8 ± 0.78	66.9	60.7	55.4 ± 1.48
Total volatiles[2]	---	0.33	1.29	1.45 ± 0.35	7.14	9.98	14.16 ± 1.97
Nonextractable residues	2.2 ± 0.14	12.5	17.1	22.7 ± 0.78	29.9	34.0	32.3 ± 4.17
Total % recovery	96.5 ± 1.41	99.4	97.0	98.9 ± 1.20	103.9	104.7	101.8 ± 0.71

Data obtained from Table 7, p. 26, and Table 11, p. 30 of the study report. Standard deviations were calculated by reviewer.

* At most sampling intervals, only a single sample was analyzed. At 0, 29, and 127 days, duplicate samples were analyzed for total extractable and nonextractable residues and total volatiles to establish the variability of the data.

1 Although these residues were identified as "others" in the study report, only one peak other than BAS 510 F was visible on the representative HPLC chromatograms. In the HPLC chromatograms, this peak is identified as 2-hydroxy-N-(4'-chlorobiphenyl-2-yl)-nicotinamide (BAS Number 391572; M510F49).

2 The study author refers to this as CO_2 in the text. In other aerobic soil metabolism studies using BAS 510 F, CO_2 is the only volatile degradate.

Table 7: Biotransformation of [^{14}C]BAS 510 F, expressed as percentage of applied radioactivity (mean ± s.d when n=2), in **Idaho clay loam** under aerobic conditions.*

Compound	Sampling times (days after treatment)						
	0	7	14	29	63	91	127
BAS 510 F	93.6	91.5	88.1	86.1	77.1	78.8	76.5
"Others"[1]	1.5	1.3	2.3	1.4	4.7	2.5	3.1
Total extractable residues	95.1 ± 0.92	92.8	90.4	87.5 ± 0.99	81.8	81.3	79.6 ± 1.41
Total volatile organics[2]	---	2.49	5.54	6.68 ± 2.47	10.55	10.88	11.51± 0.54
Nonextractable residues	1.3 ± 0.00	6.7	8.0	10.7 ± 0.21	14.4	17.7	17.8 ± 0.28
Total % recovery	96.4 ± 0.92	102.0	103.9	104.8 ± 1.70	106.8	109.9	108.9 ± 2.26

Data obtained from Table 8, p. 27, and Table 11, p. 30 of the study report. Standard deviations were calculated by reviewer.

* At most sampling intervals, only a single sample was analyzed.

1 Although these residues were identified as "others" in the study report, only one peak other than BAS 510 F was visible on the representative HPLC chromatograms. In the HPLC chromatograms, this peak is identified as 2-hydroxy-N-(4'-chlorobiphenyl-2-yl)-nicotinamide (BAS Number 391572; M510F49).

2 The study author refers to this as CO_2 in the text. In other aerobic soil metabolism studies using BAS 510 F, CO_2 is the only volatile degradate.

Table 8: Biotransformation of [^{14}C]BAS 510 F, expressed as percentage of applied radioactivity (mean ± s.d. when n = 2), in **Illinois silt loam** under aerobic conditions.*

Compound	Sampling times (days after treatment)						
	0	7	14	29	63	91	127
BAS 510 F	93.6	90.8	90.7	91.0	67.2	71.3	67.7
"Others"[1]	1.6	1.9	2.4	4.5	14.0	9.3	10.1
Total extractable residues	95.2 ± 3.39	92.7	93.1	95.5 ± 0.14	81.2	80.6	77.8 ± 0.42
Total volatile organics[2]	---	3.48	4.78	4.50 ± 1.06	5.67	6.01	5.61 ± 0.89
Nonextractable residues	1.6 ± 0.78	6.5	8.2	12.2 ± 0.64	13.6	18.9	21.7 ± 1.14
Total % recovery	96.8 ± 4.17	102.7	106.1	112.2 ± 1.84	100.5	105.5	105.1 ± 0.28

Data obtained from Table 9, p. 28, and Table 11, p. 30 of the study report. Standard deviations were calculated by reviewer.

* At most sampling intervals, only a single sample was analyzed.

1 Although these residues were identified as "others" in the study report, only one peak other than BAS 510 F was visible on the representative HPLC chromatograms. In the HPLC chromatograms, this peak is identified as 2-hydroxy-N-(4'-chlorobiphenyl-2-yl)-nicotinamide (BAS Number 391572; M510F49).

2 The study author refers to this as CO_2 in the text. In other aerobic soil metabolism studies using BAS 510 F, CO_2 is the only volatile degradate.

Table 9: Biotransformation of [^{14}C]BAS 510 F, expressed as percentage of applied radioactivity (mean ± s.d when n=2), in **North Dakota loam** under aerobic conditions.*

Compound	Sampling times (days after treatment)						
	0	7	14	29	63	91	127
BAS 510 F	96.2	82.7	73.4	75.4	62.0	59.1	54.0
"Others"[1]	1.9	2.6	1.1	1.7	3.8	2.0	3.0
Total extractable residues	98.1 ± 2.33	85.3	74.5	77.1 ± 4.03	65.8	61.1	57.0 ± 0.14
Total volatile organics[2]	---	1.82	4.25	4.93 ± 1.48	7.53	7.98	8.04 ± 1.11
Nonextractable residues	2.1 ± 0.28	24.6	24.4	28.2 ± 2.62	32.8	35.8	40.4 ± 1.48
Total % recovery	100.2 ± 2.05	111.7	103.2	110.2 ± 5.16	106.1	104.9	105.4 ± 2.40

Data obtained from Table 10, p. 29, and Table 11, p. 30 of the study report. Standard deviations were calculated by reviewer.

* At most sampling intervals, only a single sample was analyzed.

1 Although these residues were identified as "others" in the study report, only one peak other than BAS 510 F was visible on the representative HPLC chromatograms. In the HPLC chromatograms, this peak is identified as 2-hydroxy-N-(4'-chlorobiphenyl-2-yl)-nicotinamide (BAS Number 391572; M510F49).

2 The study author refers to this as CO_2 in the text. In other aerobic soil metabolism studies using BAS 510 F, CO_2 is the only volatile degradate.

C. TRANSFORMATION OF PARENT COMPOUND: BAS 510 F degraded most quickly in the California clay loam and North Dakota loam soils, with BAS 510 F comprising 54.0-54.5% of the nominal application at 127 days posttreatment (final sampling interval; Table 11, p. 30). Degradation proceeded more slowly in the Illinois silt loam soil (67.7% at 127 days) and most slowly in the Idaho clay loam soil (76.5% at 127 days). The rate of degradation appeared to be unrelated to microbial biomass, clay content, organic matter content, CEC, or pH.

In the California clay loam soil, [^{14}C]BAS 510 F decreased from 93.0% of applied radioactivity (nominal application) at day 0 to 65.6% at 63 days and 54.5% at 127 days (Table 11, p. 30). In the Idaho clay loam soil, [^{14}C]BAS 510 F decreased from 93.6% at day 0 to 77.1% at 63 days and 76.5% at 127 days. In the Illinois silt loam soil, [^{14}C]BAS 510 F was 93.6% at day 0, 90.7-91.0% at 7-29 days, and 67.2-71.3% at 63-127 days. In the North Dakota loam soil, [^{14}C]BAS 510 F decreased from 96.2% at day 0 to 62.0% at 63 days and 54.0% at 127 days.

HALF-LIFE: The half-life for BAS 510 F was determined by the reviewer using linear regression analysis based on first-order kinetics as calculated by Excel 2000.

Table 10: Half-life values of BAS 510 F in aerobic soil.

Soil type	First order Linear		
	Half-life (days)	Regression equation	r^2
California clay loam	178	Linear form y = mx + b as $lnC = -kt + lnC_0$; lnC_0 is initial concentration (b = y intercept), lnC is concentration at time t (y), k is the slope (m), t is time (x) or $kt = lnC_0 - lnC$. Half-life (t ½) = -(ln 2/k).	0.9443
Idaho clay loam	433		0.8490
Illinois silt loam	239		0.8114
North Dakota loam	173		0.8766

[1]Half-lives calculated using data obtained from data obtained from Table 11, p. 30.

TRANSFORMATION PRODUCTS: One transformation product, 2-hydroxy-N-(4'-chlorobiphenyl-2-yl)-nicotinamide, was identified by the study author. Although extractable [^{14}C]residues other than BAS 510 F are identified only as "Others" in Table 11 (p. 30), 2-hydroxy-N-(4'-chlorobiphenyl-2-yl)-nicotinamide (M510F49) is the only compound other than BAS 510 F that was isolated using HPLC (pp. 34-39). When a comparison could be made, its concentrations reported on the HPLC chromatograms correspond to the concentration of "Others".

The concentration of "Others" ranged from 0.9 to 1.6% of the applied in the California clay loam soil, from 1.3 to 4.7% in the Idaho clay loam soil, and from 1.1 to 3.8% in the North Dakota loam soil with no clear pattern of formation and decline (Table 11, p. 30). In the Illinois silt loam soil, "Others" was a maximum of 14.0% of the applied at 63 days and was 10.1% at 127 days.

NONEXTRACTABLE AND EXTRACTABLE RESIDUES: The concentrations of extractable and nonextractable [^{14}C]residues in the California clay loam soil and the North Dakota loam soil were similar (55.4-57.0% of the applied for extractables and 32.3-40.4% for nonextractables; Tables 7-10, pp. 26-29). Those in the Idaho clay loam soil and the Illinois silt loam soil were similar (77.8-79.6% for extractables and 17.8-21.7% for nonextractables). This pattern reflected the relative rates of degradation of BAS 510 F, because the formation of nonextractable residues was the primary way in which the parent compound concentration was decreased.

In the California clay loam soil, extractable [^{14}C]residues decreased from 94.3 ± 1.20% of the applied radioactivity at day 0 to 55.3 ± 1.48% at 127 days posttreatment (Tables 7 and 11, pp. 26 and 30). Nonextractable [^{14}C]residues increased from 2.2 ± 0.14% at day 0 to 32.3 ± 4.17% at 127 days.

In the Idaho clay loam soil, extractable [^{14}C]residues decreased from 95.1 ± 0.92% of the applied radioactivity at day 0 to 79.6 ± 1.41% at 127 days posttreatment (Tables 8 and 11, pp. 27 and 30). Nonextractable [^{14}C]residues increased from 1.3 ± 0.00% at day 0 to 17.8 ± 0.28% at 127 days.

In the Illinois silt loam soil, extractable [^{14}C]residues decreased from 95.2 ± 3.39% of the applied radioactivity at day 0 to 77.8 ± 0.41% at 127 days (Tables 9 and 11, pp. 28 and 30). Nonextractable [^{14}C]residues increased from 1.55 ± 0.78% at day 0 to 21.7 ± 0.14% at 127 days.

In the North Dakota loam soil, extractable [^{14}C]residues decreased from 98.1 ± 2.33% of the applied radioactivity at day 0 to 57.0 ± 0.14% at 127 days (Tables 10 and 11, pp. 29 and 30). Nonextractable [^{14}C]residues increased from 2.10 ± 0.28% at day 0 to 40.4 ± 1.48% at 127 days.

VOLATILIZATION: Volatiles totaled 14.2 ± 1.97%, 11.5 ± 0.54%, 5.6 ± 0.89%, and 8.0 ± 1.11% of applied radioactivity at 127 days in the California clay loam, Idaho clay loam, Illinois silt loam and North Dakota loam soils, respectively (Tables 7-10, pp. 26-29). There was no evidence that the volatile compounds were identified in this study. However, it is likely that $^{14}CO_2$ was the only compound volatilized from the soil, since NaOH was the only trapping solution used in this study and since organic volatiles have not been identified as a transformation product in other aerobic soil metabolism studies in this data package.

TRANSFORMATION PATHWAY: An aerobic biotransformation pathway of [^{14}C]BAS 510 F was not proposed by the registrant in this study. In MRID 45405208, it was proposed that BAS 510 F degrades to M510F49 and/or M510F50 (Unknown 2). The parent and these transformation products are degraded to CO_2 and are converted to soil bound residues.

Table 11: Chemical names and CAS numbers for the transformation products of ^{14}C-BAS 510 F.

Applicant's Code Name	CAS Number	CAS and/or IUPAC Chemical Name(s)	Chemical formula	Molecular weight	SMILES string
M510F49		2-hydroxy-N-(4'-chlorobiphenyl-2-yl)-nicotinamide		324.77	

D. SUPPLEMENTARY EXPERIMENT-RESULTS: Supplementary experiments were not performed.

III. STUDY DEFICIENCIES: This study was conducted in accordance with USEPA Subdivision N Guidelines §162-1, PMRA Guideline T-1-255, and DACO 8.2.3.4.2. Subdivision N guidelines specify that an aerobic soil metabolism study be conducted until the pattern of decline of the parent and the patterns of formation and decline of the transformation products are defined, or for 1 year, whichever is shorter. The latest sampling interval included in this report is 127 days, at which time 56-76% of the nominal application of BAS 510 F remained. This study cannot currently fulfill data requirements. It is noted, however, that the study author stated that this is an interim report and that sampling would continue through 360 days.

IV. REVIEWER'S COMMENTS:

1. The study author identifies 2-hydroxy-N-(4'-chlorobiphenyl-2-yl)-nicotinamide (BAS Number 391572) as a transformation product of BAS 510 F (p. 18). However, no quantitative concentration data are provided and in Table 11 (p. 30), extractable [^{14}C]residues are characterized only as BAS 510 F and "Others." In the representative HPLC chromatograms (p. 34-39), only one peak (or two peaks very close to each other) other than BAS 510 F is visible. The retention time for these peaks (about 24.5-25.5 minutes) is comparable to that of 2-hydroxy-N-(4'-chlorobiphenyl-2-yl)-nicotinamide (M510F49). On some chromatograms, this peak is identified as 2-hydroxy-N-(4'-chlorobiphenyl-2-yl)-nicotinamide and on other chromatograms it is identified as Region 1. The concentrations of this peak appear to correspond to the concentrations of "Others." The study author should have identified what portion of "Others" was comprised of 2-hydroxy-N-(4'-chlorobiphenyl-2-yl)-nicotinamide.

2. The [^{14}C]residues trapped in the NaOH trapping solution were not identified. The study author frequently refers to these residues as CO_2, but the presence of CO_2 in the solution was not confirmed. It is very likely that CO_2 was the only volatile compound, since NaOH is most effective as a CO_2 trap and since CO_2 was the only volatile detected in other aerobic soil metabolism studies (MRIDs 45405208, 45405209).

3. HPLC with comparison to reference standards was the only analytical method used in the study. The identification of BAS 510 F and 2-hydroxy-N-(4'-chlorobiphenyl-2-yl)-nicotinamide should have been confirmed with a additional analysis using an alternate method such as MS.

4. The conditions under which volatile trapping occurred were not described in detail, and the efficiency of the NaOH traps was not reported.

5. Although two samples were collected at each sampling interval, only single samples were analyzed at most intervals. Replicate sampling at each sampling interval is necessary, so that normal variability can be quantified and outliers can be identified.

6. The registrant determined linear regression half-lives using Origin 6.0 Scientific Graphics Software. The Hamaker equation was used to describe dissipation kinetics using a linear fit. The natural log of 2 (0.693) was then divided by the slope of the line for determination of the rate constant, to determine the half-life value (p. 18). The registrant-calculated half-lives were 184 days for the California clay loam soil, 438 days for the Idaho clay loam soil, 264 days for the Illinois silt loam soil, and 177 days for the North Dakota loam soil. These values are comparable to the half-lives obtained by the reviewer using linear regression with Excel 2000 software. Since the study was terminated before the half-life was observed in any soil, the value of the calculated half-lives is limited. These half-lives are extrapolated values that do not consider possible changes in the rate of degradation that may occur with time.

7. BAS 510 F chemical name 2-chloro-*N*-(4'-chlorobiphenyl-2-yl)-nicotinamide, as presented in the study report, was identified as the IUPAC name by the Compendium of Pesticide Common Names (http://www.hclrss.demon.co.uk/nicobifen.html). The CAS name 2-chloro-*N*-(4-chloro[1,1-biphenyl]-2-yl)-3-pyridinecarboxamide was also obtained from the Compendium of Pesticide Common Names. The following BAS 510 F synonyms were obtained from USEPA/OPP Chemical Databases (http://www.cdpr.ca.gov/cgi-bin/epa/chemidetriris.pl?pccode=128008 and (http://www.cdpr.ca.gov/cgi-bin/mon/bycode.pl?p_chemcode=5790): 2-chloro-*N*-(4'-chlorobiphenyl-2-yl)-nicotinamide, nicobifen, and BAS 516 02 F.

V. REFERENCES:

1. Microcal Software, Inc., Origin 6.0, One Roundhouse Plaza, Northampton, MA 01060.

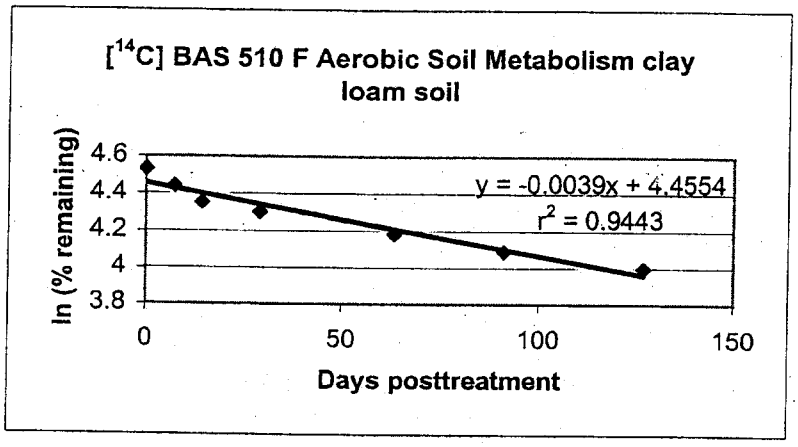
Attachment 1

Excel Spreadsheets

162-1, Aerobic biotransformation of BAS 510 F
MRID 45405210
California soil

Half-life (days) =	177.73	DT90 =	590.41

Days posttreatment	% BAS 510 F remaining	LN (%remaining)
0	93	4.532599493
7	85	4.442651256
14	77.7	4.352855257
29	73.9	4.302712828
63	65.6	4.183575696
91	59.7	4.08933202
127	54.5	3.998200702

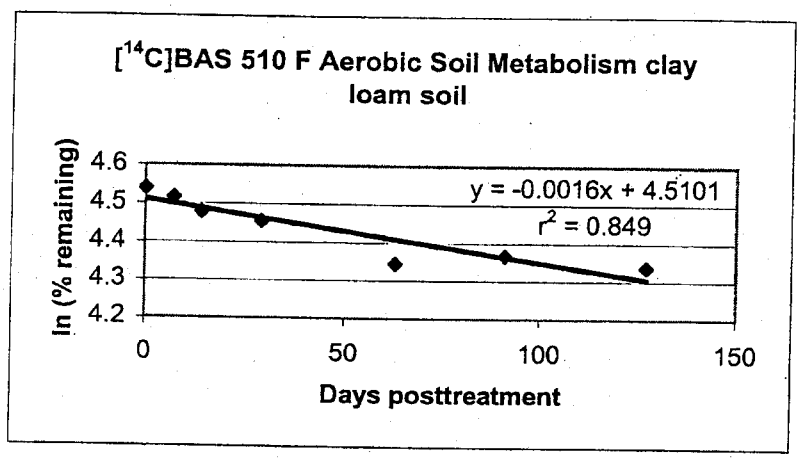


Constant	4.4554
r2	0.94
x (slope)	-0.0039

162-1, Aerobic biotransformation of BAS 510 F
MRID 45405210
Idaho

Half-life (days) =	433.22	DT90 =	1439.12

Days posttreatment	% BAS 510 F remaining	LN (%applied)
0	93.6	4.539030383
7	91.5	4.516338972
14	88.1	4.478472533
29	86.1	4.455509411
63	77.1	4.345103281
91	78.8	4.366912997
127	76.5	4.337290741



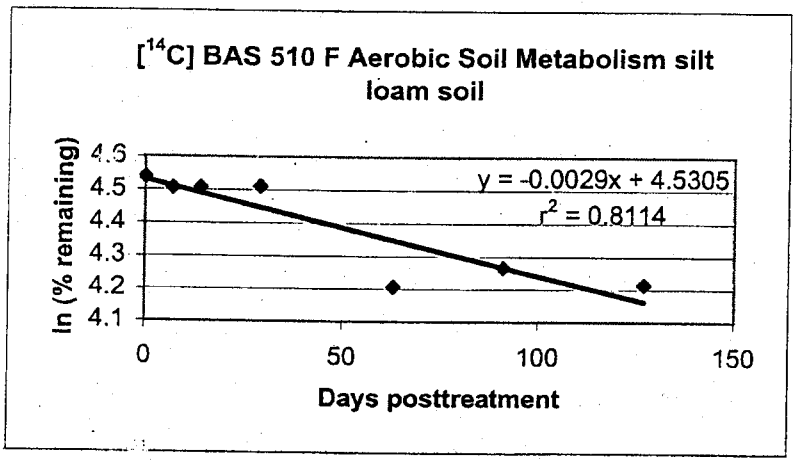
Constant	4.5101
r2	0.849
x (slope)	-0.0016

EC

162-1, Aerobic biotransformation of BAS 510 F
MRID 45405210
Illinois

Half-life (days) =	239.02	DT90 =	793.99

Days posttreatment	% BAS 510 F remaining	LN (%remaining)
0	93.6	4.539030383
7	90.6	4.506454213
14	90.7	4.507557357
29	91	4.510859507
63	67.2	4.207673248
91	71.3	4.266896327
127	67.7	4.21508618

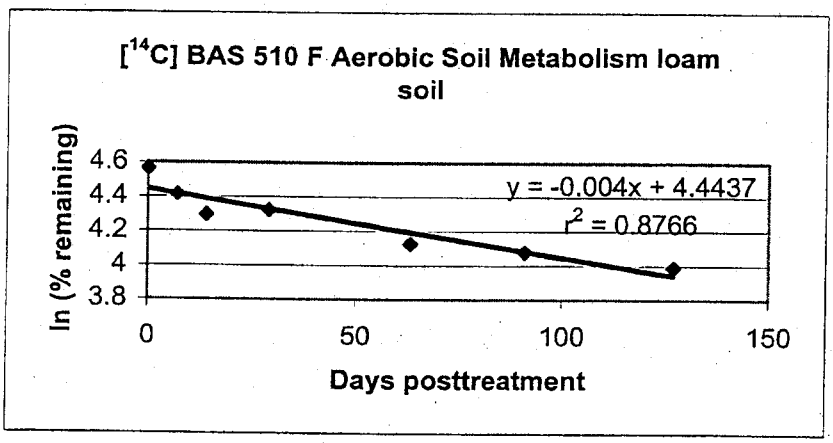


Constant	4.45305
r2	0.81
x (slope)	-0.0029

162-1, Aerobic biotransformation of BAS 510 F
MRID 45405210
North Dakota

Half-life (days) =	173.29	DT90 =	575.65

Days posttreatment	% BAS 510 F remaining	LN (%remaining)
0	96.2	4.566429358
7	82.7	4.415219602
14	73.4	4.295923936
29	75.4	4.322807275
63	62	4.127134385
91	59.1	4.079230924
127	54	3.988984047



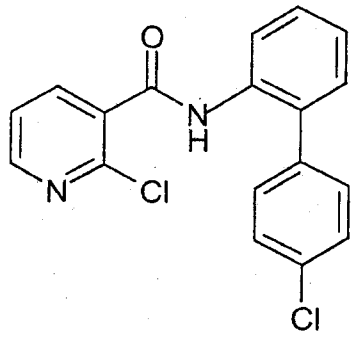
Constant	4.4437
r2	0.88
x (slope)	-0.004

Attachment 2

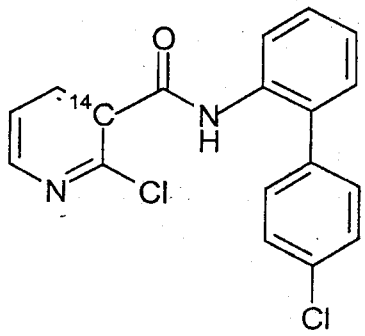
Structure of Parent and Degradate

BAS 510 F

IUPAC name: 2-Chloro-*N*-(4-chlorobiphenyl-2-yl)-nicotinamide.
CAS name: 2-Chloro-*N*-(4-chloro[1,1-biphenyl]-2-yl)-3-pyridinecarboxamide.
CAS No: 188425-85-6.
Synonyms: 2-Chloro-*N*-(4'-chlorobiphenyl-2-yl)-nicotinamide, Nicobifen. BAS 516 02 F.



[Pyridine-3-^{14}C]-labeled BAS 510 F



M510F49, 2-Hydroxy-N-(4'-chlorobiphenyl-2-yl)nicotinamide, Reg No. 391572