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ESPAÑA

Monograph prepared in the context of the inclusion of the following active
substance in Annex I of the Council Directive 91/414/EEC

ENDOSULFAN

Addendum Volume III

May 2002

THE ADDENDUM WAS PREPARED UNDER THE RESPONSIBILITY OF:

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CHAPTER B-1: Identity

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CHAPTER B-8: Environmental fate and behaviour

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CHAPTER B-9: Ecotoxicology

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ADDENDUM TO ANNEX B

ENDOSULFAN

B - 1: IDENTITY

B.1 Identity

The main notifier (Task Force Aventis/ Makhteshim) proposed a new list of GAP at the ECCO 106. **Cotton and tomatoes have been selected as representative uses for Annex I inclusion.** Although based on the annotation made by Aventis/Makhteshim, the task force supports all the uses listed in the previous list of GAP and intends to seek registrations in some Member States after Annex I listing of the active substance. **The previous list of GAP included citrus, hazelnut, pome fruits, stone fruits, grapes, sugar beet, pepper, potatoes and the following imported crops tea, soyabean, citrus, coffee. The RMS took into account all these uses in the risk assessment that was discussed during the ECCO Peer Review and several data GAPs were identified; a safe use was not identified in the ECCO Peer Review.**

The new risk assessment is made for **COTTON and TOMATO**, all the other uses are not supported by the available information.

The evaluation of the new information received from the main notifier have been included in the evaluation table.

LIST OF USES SUPPORTED BY AVAILABLE DATA – REPRESENTATIVE USES (DATE: 28.09.2001)

Active substance: **Endosulfan**

Crop and/ or situation (a)	Member State or Country	Product name	F G or I I (b)	Pests or Group of pests controlled (c)	Formulation		Application				Application rate per treatment			PHI (days) (l)	Remarks: (m)
					Type (d-f)	Conc. of as (i)	method kind (f-h)	growth stage & season (j)	number min max (k)	interval between applicat- ions (min)	kg as/ha min max	water l/ha min max	kg as/ha min max		
Cotton	Southern Europe	Thiodan 35 EC	F	I, A	EC	350 g/l	Medium /high volume spray	Last applicat ion when balls are partly open	3	14 – 21 days	0.105	800	0.84	21	Short PHI of 21 days is required, if chem. agent is used for desiccation of foliage.
Tomatoes	Southern Europe	Thiodan 35 EC	F	I, A	EC	350 g/l	Medium /high volume spray	At any stage	2	14 days	0.053 – 0.105	500 - 1000	max. 0.53	3	
			G						2	14 days	0.053	1500	0.8	3	

Remarks:

- (a) For crops, the EU and Codex classifications (both) should be used; where relevant, the use situation should be described (e.g. fumigation of a structure)
- (b) Outdoor or field use (F), glasshouse application (G) or indoor application (I)
- (c) e.g. biting and sucking insects, soil born insects, foliar fungi, weeds
- (d) e.g. wettable powder (WP), emulsifiable concentrate (EC), granule (GR)
- (e) GCPF Codes - GIFAP Technical Monograph No 2, 1989
- (f) All abbreviations used must be explained
- (g) Method, e.g. high volume spraying, low volume spraying, spreading, dusting, drench
- (h) Kind, e.g. overall, broadcast, aerial spraying, row, individual plant, between the plants - type of equipment used must be indicated
- (i) g/kg or g/l
- (j) Growth stage at last treatment (BBCH Monograph, Growth Stages of Plants, 1997, Blackwell, ISBN 3-8263-3152-4), including where relevant, information on season at time of application
- (k) The minimum and maximum number of application possible under practical conditions of use must be provided
- (l) PHI - minimum pre-harvest interval
- (m) Remarks may include: Extent of use/economic importance/restrictions

ADDENDUM TO ANNEX B

ENDOSULFAN

B - 8: ENVIRONMENTAL FATE AND BEHAVIOUR

B.8 Environmental fate and behaviour

The main concern after the ECCO Meeting 103 was that DT50 and DT90 values could not be established for the metabolite endosulfan sulphate from the submitted studies and further data are required.

With the studies included in the original dossier the RMS concluded that the degradation of endosulfan in soil did not show any alteration of the hexachlor norbornene bicyclic and showed a very low mineralization (<5%). These two facts suggest a high persistence of a soil residue constituted by a number of chlorinated metabolites, which may not account individually for more than 10% of applied dose but that all together may represent high amount of it. Therefore a wider investigation of the degradation routes of this compound was required.

The notifier has submitted a aerobic soil degradation study of the metabolite endosulfan sulfate and a field dissipation study on cotton crop in Sapin.

B.8.1 Aerobic soil degradation study

B.8.1.1 Aerobic soil degradation study of ENDOSULFAN SULFATE

Study: endosulfan: [¹⁴C]AE F051327: Soil Metabolism and degradation

Author: Dr. Frank Schnöder

Dated: 1 February 2002

Reference: C019647

GLP: Yes

An aerobic soil degradation study was performed with ¹⁴C-ring labelled [¹⁴] AEF051327 (endosulfan sulfate) (radiochemical purity 99.4-99.9%) in order to investigate the metabolism and degradation rate of the test item in four soils (LS 2.2, SLS, SP and HE) inflow-through test systems. The characteristics of the soils are summarised in table 8.1.1-1

Table 8.1.1-1: Characteristics of the soils

Parameters/ soil	LS 2.2	HE	SP	SLS
Origin/supplier	LUFA Spreyer/LUFA spreyer	Greece/Aventis Crop Science GmbH	Spain/Aventis Crop Science GmbH	Hattersheim/Aventis Crop Science GmbH
pH (CaCl ₂)	6.4	7.4	6.2	7.0
Organic carbon (g/100 g soil)	2.1	1.6	0.5	1.0
CEC (meq/100 g soil)	11.7	26.2	9.8	13.8
Particle size distribution (BBA and UK)				
Soil type (BBA)	Sandy loam	Clay	Sandy silt loam	Clay loam
< 0.002 mm (clay) %	11	39	13	20
0.002-0.063 mm (silt) %	15	44	39	60
0.063-2.0 mm (sand) %	74	17	48	20
Particle size distribution (USDA)				

Soil type (USDA)	Sandy loam	Silty clay loam	Loam	Silt loam
Sand % (2000-53 μm)	75	18	50	21
Silt % (53-2 μm)	14	43	37	59
Clay % (<2 μm)	11	39	13	20
MWC (g/100 g soil)	48.0	52.2	34.3	48.8
FC (g/100 g soil)	15.5	33.0	19.1	22.0
Biomass ($\mu\text{g C}/100\text{ g dry soil}$)				
Following collection	642	609	241	218
Start of study	501	n.a	141	119
Day 90	411	790	185	132
Day 180	630	409	123	272
Day 260	405	623	218	285
Day 365	274	472	66	173

n.a: no available. Biomass for this soil could not be re-determined due to limited amount of soil available.

Following a single application of the test item at a rate of 0.840 kg/ha (field application), the soil was incubated under aerobic conditions at $20\pm 2^\circ\text{C}$ and a moisture of 30 to 40% of the maximum water holding capacity in the dark for a period of 365 days in total. Soil samples of 150 g dry weight equivalent were prepared by weighing the sieved soil into individual 500 ml glass flasks. These flasks were placed in desiccators and a stream of moistened air was allowed to pass through the incubation system. Volatile components and $^{14}\text{CO}_2$ were collected by a system of traps. The first trap was empty and acted as a security trap, the second and third contained ethanediol and 2% liquid paraffin in decane to trap polar and non-polar volatiles, respectively, and the final two contained 2 M sodium hydroxide solution to trap liberated carbon dioxide. Effluent air from the desiccators was drawn through the traps.

In order to maintain the microbial activity throughout the incubation period all soil samples under incubation were fortified with 50 g fresh soil 3, 6 and 9 months after application and the samples were intensively mixed after fortification. By day 90, 180 and 260, samples were fortified with freshly collected soil. As a consequence, the weight of samples worked up by day 120, 240 and 365 was 200 g, 250 g and 300 g soil in total, respectively.

Duplicate samples were removed at different time intervals and analysed after extraction for parent molecule and degradation products by HPLC using UV- and ^{14}C -flow through detection. In order to maintain a high microbial activity, a number of soil samples was stepwise fortified each untreated and freshly collected soil by days 90, 180 and 260 after application.

The soils extracts were also analysed for the expected transformation products, endosulfan diol (AE F051329), endosulfan lactone (AE F051328) and endosulfan hydroxy carboxylic acid (AE 0365278) by radio-HPLC.

The individual mass balances ranged from 82.25% to 113.64%, 68.74% to 104.31%, 83.82% to 104.65% and 67.18% to 104.70% AR for soils LS2.2, HE, SP and SLS, respectively. The lowest recoveries (82.25%, 68.74%, 83.82% and 67.18% AR for soils LS2.2, HE, SP and SLS) were observed

for the samples fortified with fresh soil at the later sampling intervals. The losses can be explained by an inhomogenic distribution of the test item and its residues in the samples as aliquots only were removed for the work-up. Due to the metabolic conversion, the extractable radioactivity continuously decreased for all soils tested in the course of the experiment. The values are in a range from 109.32% to 19.79% AR, 98.88% to 22.22% AR, 98.68% to 54.84% AR and 90.71 % to 13.40% AR in soils LS2.2, HE, SP and SLS by day 0 to day 365, respectively. In parallel, the formation of non- extractable radioactivity increased to 27.52%, 29.79%, 24.60% and 32.56% of the applied dose for soil LS2.2, HE, SP and SLS after 365 days, respectively. The volatile radioactivity was found in sodium hydroxide traps only. By the end of the study, the volatiles accounted for 34.97%, 16.67%, 4.95% and 23.40% AR for soils LS2.2, HE, SP and SLS, respectively. Their identity as ¹⁴C-carbon dioxide was confirmed by a complete precipitation of radioactivity as barium carbonate for selected samples.

For all soils, the majority of radioactivity in the organic extracts was represented by the test item. The values for the test item decreased from 106.14%, 95.21%, 97.29% and 86.27% AR day 0 to 18.10%, 20.06%, 45.63% and 11.21% AR for soil LS2.2, HE, SP and SLS after 365 days, respectively. The soil extracts were also analysed for the expected transformation products endosulfan diol (AE F051329), endosulfan lactone (AE F051328) and endosulfan hydroxy carboxylic acid (AE 0365278) by radio-HPLC. However, none of these potential metabolites was detected at any sampling interval in the course of the study. A small portion of radioactivity in HPLC chromatograms was not assigned to a distinct peak. This "diffuse radioactivity" amounted to only 1.27% AR in soil LS2.2, 1.61% AR in soil HE 1.01% AR in soil SP and 1.15% AR in soil SLS in maximum.

An unknown metabolite was detected in all soils at a number of time points. The maximum values were 10.78% by day 30 (soil LS2.2), 28.3% by day 59 (soil HE) 2.32% by day 59 (soil SP) and 11.84% by day 59 (soil SLS) for the extractable radioactivity (organic and water phase). For all soils, the unknown component was not detected by HPLC in any sample by day 365. The unknown metabolite was subject of further investigation for the elucidation of its chemical structure. Selected HPLC fractions (soils LS2.2 and HE from day 30 and 120, and SLS, day 30, both replicates each) containing the unknown component were investigated by Covance Laboratories Ltd, Harrogate, UK (CLEH) and by the University of York, York, UK. Several mass spectroscopy (MS) techniques as well as derivatisation techniques and analyses of the isolated unknown were applied, however, there was not sufficient evidence to result in a distinct structural proposal. As a likely structure, a dicarboxylic acid, dihydrodiol metabolite is under discussion. **The notifier informed in the report that additional efforts for the structural elucidation are underway and that the results of these further attempts will be amended in a separate report. This information is essential for the residue definition.**

Table 8.1.1-2: Degradation products (organic extracts) from soil LS2.2 (%AR)

Time (days)	Sulfate	Diol	Lactone	Hydroxy carboxylic acid	Unknown	Unresolved	Volatiles	Soil residue
0	104.39	< LOD	< LOD	< LOD	< LOD	0.98	0	2.53

7	93.21	< LOD	< LOD	< LOD	< LOD	1.16	0.19	4.07
14	86.21	< LOD	< LOD	< LOD	3.54	1.27	0.59	5.34
30	74.57	< LOD	< LOD	< LOD	5.31	0.90	2.80	8.28
59	68.96	< LOD	< LOD	< LOD	7.70	1.19	6.29	12.64
120	47.88	< LOD	< LOD	< LOD	9.15	0.32	13.08	19.94
240	23.88	< LOD	< LOD	< LOD	4.34	0.12	26.73	28.55
365	14.82	< LOD	< LOD	< LOD	< LOD	0.18	35.00	27.52

Table 8.1.1-3: Degradation products (organic extracts) from soil HE (%AR)

Time (days)	Sulfate	Diol	Lactone	Hydroxy carboxylic acid	Unknown	Unresolved	Volatiles	Soil residue
0	95.21	< LOD	< LOD	< LOD	< LOD	0.25	0	4.01
7	86.53	< LOD	< LOD	< LOD	0.67	0.63	0.20	6.13
14	85.24	< LOD	< LOD	< LOD	2.99	1.12	0.33	7.62
30	62.12	< LOD	< LOD	< LOD	15.23	1.61	1.35	11.18
59	56.67	< LOD	< LOD	< LOD	14.38	0.41	3.09	17.54
120	48.62	< LOD	< LOD	< LOD	6.88	0.41	6.67	28.51
240	30.17	< LOD	< LOD	< LOD	5.83	0.28	10.94	32.97
365	18.05	< LOD	< LOD	< LOD	< LOD	0.10	16.71	29.79

Table 8.1.1-4: Degradation products (organic extracts from) soil SP (%AR)

Time (days)	Sulfate	Diol	Lactone	Hydroxy carboxylic acid	Unknown	Unresolved	Volatiles	Soil residue
0	95.10	< LOD	< LOD	< LOD	< LOD	0.97	0.00	2.60
7	84.94	< LOD	< LOD	< LOD	< LOD	1.03	0.24	4.47
14	86.36	< LOD	< LOD	< LOD	< LOD	1.79	0.39	4.80
30	87.93	< LOD	< LOD	< LOD	< LOD	0.64	0.52	6.95
59	88.82	< LOD	< LOD	< LOD	< LOD	1.19	0.83	10.10
120	75.74	< LOD	< LOD	< LOD	< LOD	1.15	1.01	15.02
240	64.78	< LOD	< LOD	< LOD	2.19	0.56	1.95	24.04
365	45.55	< LOD	< LOD	< LOD	< LOD	0.04	4.95	24.60

Table 8.1.1-5: Degradation products (organic extracts from) soil SLS (%AR)

Time (days)	Sulfate	Diol	Lactone	Hydroxy carboxylic acid	Unknown	Unresolved	Volatiles	Soil residue
0	86.65	< LOD	< LOD	< LOD	< LOD	1.11	0.00	2.11
7	85.84	< LOD	< LOD	< LOD	< LOD	1.14	0.25	4.95

14	89.26	< LOD	< LOD	< LOD	1.94	1.21	0.30	4.58
30	80.16	< LOD	< LOD	< LOD	6.37	0.54	1.03	8.59
59	72.93	< LOD	< LOD	< LOD	7.13	0.97	2.77	13.47
120	51.92	< LOD	< LOD	< LOD	4.98	0.69	6.18	22.68
240	24.43	< LOD	< LOD	< LOD	5.73	0.17	13.54	33.61
365	8.36	< LOD	< LOD	< LOD	< LOD	0.03	23.40	32.56

The disappearance times for 50% and 90% of the test item were calculated by applying a first order kinetics and a one compartment approach. The results are summarised in the table 8.1-6

Table 8.1.1-6: DT50 and DT 90 values according first order kinetics

Soil	LS2.2	SLS	SP	HE
DT ₅₀ (days)	123	141	391	147
DT ₉₀ (days)	409	468	1299	489
R ²	0.97	0.92	0.93	0.98

The calculations show consistent DT₅₀ values for soils LS2.2, HE and SLS, but a significant higher value for soil SP. The degradation kinetics determined for the Spanish soil SP might indicate a certain persistence of endosulfan sulfate. The soil SP used in this study originated from the same site than the soil dissipation study described below (see B.8.1.2).

The non-extractable radioactivity in soil was investigated by treatment of aliquots of an extracted soil sample of soil HE sampling date 240d, replicates A and B, with aqueous acid and base. By acidic extraction, 28.43% (replicate A) and 28.31 % AR (replicate B) still remained unextractable in the soil. Minor amounts of 0.87% (replicate A) and 0.88% AR (replicate B) were detected in the acidic extract. Following the alkaline extraction, only 3.89% (A) and 4.08% of AR (B) were present in the basic extract, while 25.28% (A) and 26.41 % AR (B) remained unextracted in the soil.

A fortification of soil samples with fresh soil starting by day 90 after application was carried out to basically show the degradability of agro residues of endosulfan sulfate when microbial activity is maintained as in the field. The monitoring of microbial biomass showed that the microbial activity in samples of soil SP suffered more in the course of the experiment than in the other soils tested. In addition, a strong formation of clods was observed when trying moisturise the soil to a value of 40% of the maximum water holding capacity. Consequently, a reduced test moisture of 30% only was used. A lower soil moisture and the more sensitive microbial activity while handling the soil sample in the laboratory testing were presumably the two main factors responsible for the prolonged disappearance times observed in soil SP.

Evaluation and comments: The study is considered acceptable. The study shows that endosulfan sulfate, is subject to a moderate, but complete degradation accompanied by a significant formation of carbon dioxide. The DT50 of endosulfan sulfate was calculated in a range of 123 – 391 days, the mineralisation at 120 days was in a range of 1.01 - 13.08%. The bounded residues were < 70%.

The previous assays, included in the monograph, demonstrated that the mineralisation of endosulfan were below 5%. The mineralisation of endosulfan sulfate is in line with the mineralisation of endosulfan. Based on the results of the previous studies and the result of the endosulfan sulfate aerobic degradation study it can be said that endosulfan is degraded to endosulfan sulfate and the mineralisation of endosulfan sulfate at 120 days is in a range of 1.01 – 13.08% and at 365 days is in a range of 5 – 35% depending on the type of soil.

None of the metabolites detected and identified in previous assays (included in the monograph) were detected in this study. However there is an unknown metabolite that appeared at level above 10% AR, all the attempts made for the identification of this metabolite failed but as a likely structure, a dicarboxylic acid, dihydrodiol metabolite is suspected. **The identification of this metabolite is essential for the definition of the degradation route of endosulfan, for the residue definition and for the field dissipation studies required. Furthermore in the field dissipation studies included in the monograph the endosulfan diol was detected.**

B.8.1.2 Field dissipation study

B.8.1.2.1 Field Soil dissipation study in Spain

Study: endosulfan: Field Soil dissipation study in Spain

Author: Hardy I.A.J.

Dated: 27 September 2001

Reference: C015651

GLP: Yes

The environmental behaviour of the insecticide endosulfan was studied in the field after summer application at one location in the cotton growing area of Andalucía, Spain. In June 2000 the plot was cultivated and twice irrigated by sprinkler over the next 15 days, prior to the sowing of cotton on the 10 July 2000. Spraying of the Endosulfan formulation, AE F002671 00EC33 C703 took place on the 11 July 2000 at a nominal application rate of 840 g a.i./ha. Soil samples from different depths to a maximum of 0.3 m below the surface were then collected at regular intervals over 9 months and analysed for α -endosulfan, β -endosulfan and endosulfan sulphate.

The soil has been characterised as a loam using the USDA system. The average organic carbon content in the surface soil was 0.5%. Soil microbial biomass was typical of an agricultural soil, varying from 130 to 172 $\mu\text{g C (g soil)}^{-1}$ throughout the study. The soil used in this study was the same SP-soil used in the aerobic soil degradation study of endosulfan sulfate described in point B.8.1.1. Soil characteristics are the following

Organic carbon	0.5 wt%
pH in H ₂ O	6.4

CEC	7.5 mEq (100g) ⁻¹
USDA classification	Loam
Sand	46
Silt	44
Clay	10
Microbial bioamass	130 – 172 µg C (g soil) ⁻¹
Water Holding capacity	37.5 – 43.9 %

The calibrated application rate of endosulfan was 840 g a.i./ha, with the calibrated rate from the spray measurements being 775 g a.i./ha. The application was confirmed by analysing the content of filter papers placed on the soil and by analysing soils taken immediately after application. The results from filter papers and immediate post-application soil samples were found to be lower than the calibrated application rate, being in the range 54 to 68%.

The raw residue data are presented in table 8.1.2.1-1, since laboratory recoveries are generally within the acceptable range of 70 to 110%, the measured residue values were used without correction. The concentration in wet soil were converted to dry weight values using the ration of soil wet weight to dry weight. Residue levels in mg/kg were converted to residue rates in g/ha, considering a density of soil of 0.0015 kg/cm³. The resulting parent compound residue decay rate versus days after application was evaluated by a pesticide dissipation model (ModelManager), with endosulfan sulfate being evaluated using multicompartment kinetic model (TopFit) to determine a degradation half life.

Table 8.1.2.1-1: Raw soil residue data

DAT	Hor (cm)	α-endosulfan					β-endosulfan					Endo-sulfate				
		mg/kg					mg/kg					mg/kg				
		1	2	3	4	Av	1	2	3	4	Av	1	2	3	4	Av
-1	0-30	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
0	0-10	0.25	0.25	0.25	0.26	0.25	0.1	0.1	0.09	0.11	0.1	<0.01	<0.01	<0.01	<0.01	<0.01
1	0-10	0.1	0.14	0.13	0.08	0.11	0.07	0.09	0.09	0.05	0.075	<0.01	<0.01	<0.01	<0.01	<0.01
	10-20	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
3	0-10	0.06	0.07	0.09	0.11	0.082	0.04	0.06	0.09	0.10	0.29	0.01	0.01	0.02	0.02	0.015
	10-20	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
7	0-10	0.04	0.04	0.04	0.05	0.042	0.04	0.04	0.06	0.05	0.047	0.01	0.01	0.02	0.02	0.015
	10-20	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
14	0-10	0.02	0.02	0.03	0.02	0.022	0.04	0.03	0.04	0.04	0.037	0.03	0.02	0.03	0.03	0.027
	10-20	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
30	0-10	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.02	0.01	0.01	0.015	0.02	0.02	0.01	0.02	0.017
	10-20	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
60	0-10	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.02	0.02	0.01	0.017
	10-20	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
120	0-10	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.02	<0.01	<0.01	0.012
	10-20	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
180	0-10	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

	10-20	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
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The decline kinetics were modelled, with Model manager, for α and β -endosulfan and total endosulfan ($\alpha + \beta$ -endosulfan) using both simple first order (SFO) and first order multi compartment (FOMC) models). The FOMC model giving the best fit for DT50 and DT90. The results of this calculation are showed in table 8.1.2.1-2

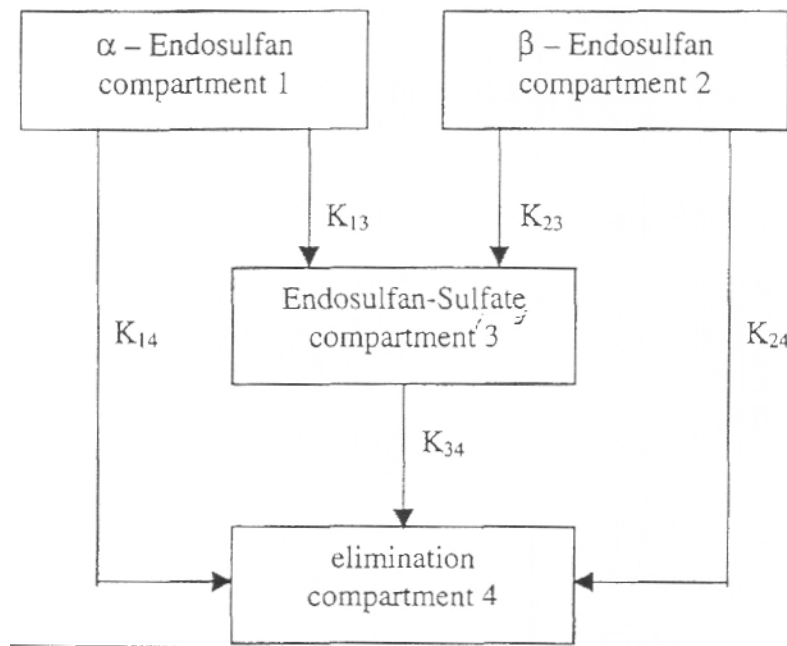
Table 8.1.2.1-2: Endosulfan degradation kinetic data produced by Model Manager

	ENDOSULFAN KINETICS			
	r ²	order	DT50 (days)	DT90(days)
α -endosulfan	0.91	SFO	1.4 (1.1 to 1.7)	4.6 (3.7 to 5.6)
	0.96	FMOF	1.4 (1.0 to 1.8)	8.9 (6.9 to 10.8)
β -endosulfan	0.87	SFO	7.9 (6.1 to 9.8)	26.4 (20.2 to 32.6)
	0.97	FMOF	7.5 (6.0 to 9.1)	36.6 (31.6 to 41.6)
Total endosulfan ($\alpha+\beta$)	0.87	SFO	2.5 (1.9 to 3.0)	8.2 (6.3 to 10.1)
	0.98	FMOF	3.5 (2.8 to 4.2)	17.7 (15.1 to 20.2)

Since FMOF is not a first order kinetic, a depends on the initial concentration the DT50 derived from this calculation is not validated by the RMS. The DT50 of dissipation considered valid is the DT50 from the first order kinetic adjust and the goodness of fit was considered valid by the RMS

Endosulfan sulfate is derived from α and β -endosulfan and was therefore evaluated with TopFit 2.0, a multicompartment kinetic model, in order to determine a true degradation half-life (figure 8.1.2.1-1).

Figure 8.1.2.1-1: Top Fit Compartment model schematic



The results of the Top Fit compartment model are showed in table 8.1.2.1-3

Table 8.1.2.1-3: TopFit compartment model output

		K_{ij} (d⁻¹)	DT50 (d)	r²
α -endosulfan	Σk_{ij}	0.4849	1.4	0.939
	k_{13}	0.0249	-	-
	k_{14}	0.460	-	-
β -endosulfan	Σk_{ij}	0.0897	7.7	0.938
	k_{23}	0.0124	-	-
	k_{24}	0.0773	-	-
Endosulfan sulfate	Σk_{ij}	0.00922	75.2	0.891
	k_{34}	0.00922	-	-
All data sets	-	-	-	0.923

Evaluation and comments: Endosulfan rapidly dissipated under field conditions. α -endosulfan (DT50 1.4 days, DT90 4.6 days) disappeared more rapidly than β -endosulfan (DT50 7.9 days, DT90 26.4 days), with total parent endosulfan ($\alpha+\beta$) residues also declining rapidly (DT50 2.5 days, DT90 8.2 days). Total parent endosulfan residues were less than 10 % of applied within 1 month. The soil metabolite endosulfan sulfate achieved a maximum residue of 7.5 % of applied parent at 14 days and then declined (DT50 75.2 days, DT90 249.7 days) to leave no detectable residues after 6 months. As the concentration over the whole period was only slightly above the LOQ, the results of the kinetic modelling are influenced by a high element of uncertainty.

According to the Topfit compartment analysis one can say that the contribution of the degradation of α - β -endosulfan to the formation of endosulfan sulfate was lower than their contribution to the unknown compartment, since the degradation kinetic constants k_{14} and k_{24} were higher than k_{13} and k_{23} .

α -, β -Endosulfan and endosulfan sulfate were found to have low mobility under field conditions despite precipitation plus irrigation exceeding average local rainfall during the period of the study. No residues were found in the soil deeper than 10 cm, thus this field study demonstrates the low potential for unsaturated zone movement and negligible potential for α -, β -Endosulfan or endosulfan sulfate to appear in groundwater.

The endosulfan soil dissipation will be reassessed when the unknown metabolite of the aerobic soil degradation of endosulfan sulfate study will be identified.

B.8.1.2.2 Field Soil dissipation study in Greece

Study: Field soil dissipation of endosulfan following single application to bare cotton plots at 1 location in Greece, 2000.

Author: Dr. Marcus Balluf

Dated: 10 December 2001

Reference: C018180

GLP: Yes

The objective of this study was to gain soil samples for the determination of residues and an estimation of the environmental behaviour of endosulfan after a single application of endosulfan on three bare soil plots at one site in Pilea (Thessaloniki), Greece. One day prior to application the site was cultivated with cotton.

Endosulfan was applied on the 30 June 2000 to three plots. A non-treated plot served as a control plot. The test item was applied with a calibrated boom sprayer at arate of 840 g ai/ha in 800 L/ha water. Soil samples from fue non-treated plot were taken immediately before the application, 6 months and 12 months after the application.

Soil samples from fue treated plots were taken immediately after the application and 1 day, 3 days, 7 days, 14 days, 1 month, 2 months, 4 months, 6 months, 9 months and 12 months after the application. Samples were taken from different depths to a maximum of 0.3 m below the surface. They were stored and shipped deep-frozen. Residue analysis was performed by Institut Fresenius Chemische und Biologische Laboratorien GmbH, Taunusstein, Germany on fue three components of the relevant residues: α -endosulfan, β -endosulfan and endosulfan-sulfate. The limit of quantification (LOQ) was 0.01 mg/kg soil for each of the components. The raw soil residue data are showed in table 8.1.2.2-1.

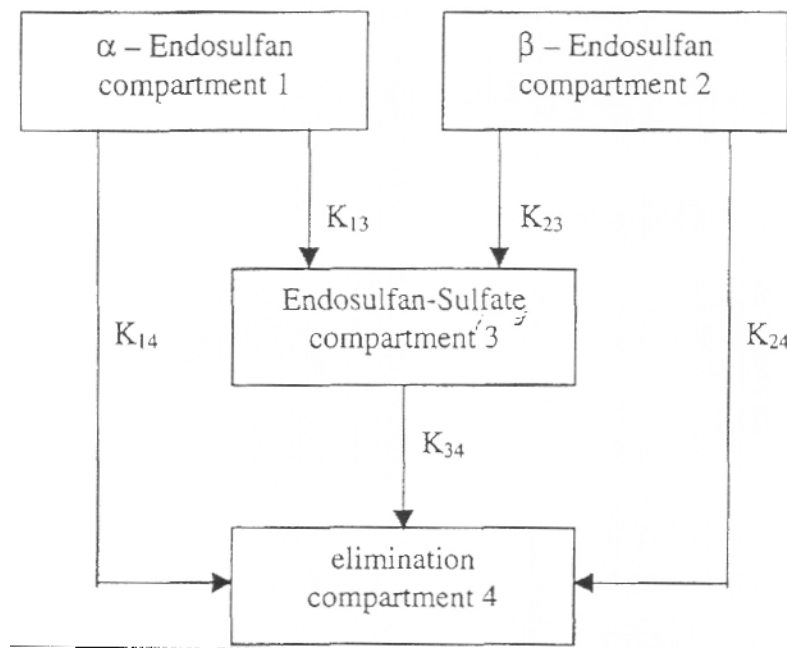
Table 8.1.2.2-1: Raw soil residue data (mg/kg dry soil)

DAT		0	1	3	7	14	28	59	120	187	277	369
Hor (cm)	Average											
0-10	α	0.483	0.183	0.167	0.140	0.117	0.063	<0.01	<0.01	0.003	<0.01	<0.01
	β	0.210	0.117	0.087	0.097	0.093	0.080	0.015	<0.01	<0.01	<0.01	<0.01
	sulfate	<0.01	<0.01	<0.01	0.033	0.040	0.047	0.037	0.027	0.01	0.018	0.01
	Total	0.698	0.305	0.258	0.270	0.250	0.190	0.057	0.037	0.018	0.028	0.020
10-20	α	none	0.020	0.005	0.005	0.010	0.037	0.005	0.005	0.002	0.003	0.002
	β	none	0.010	0.010	0.005	0.010	0.042	0.007	0.005	0.005	0.005	0.005
	sulfate	none	0.002	0.003	0.005	0.005	0.032	0.015	0.005	0.005	0.027	0.008
	Total	none	0.032	0.018	0.015	0.025	0.110	0.027	0.015	0.012	0.035	0.015
20-30	α	none	0.002	0.002	0.003	0.003	0.013	0.000	0.000	0.000	0.002	0.002
	β	none	0.005	0.005	0.005	0.005	0.015	0.003	0.007	0.000	0.003	0.002
	sulfate	none	0.003	0.005	0.005	0.003	0.015	0.002	0.003	0.002	0.005	0.003
	Total	none	0.010	0.012	0.013	0.012	0.043	0.005	0.010	0.002	0.010	0.007

g/ha												
0-30	α	725.0	307.5	260.0	222.5	195.0	170.0	15.0	15.0	7.5	15.0	12.5
	β	315.0	197.5	152.5	160.0	162.5	205.0	37.5	25.0	15.0	20.0	17.5
	sulfate	7.5	15.0	20.0	65.0	72.5	140.0	80.0	52.5	25.0	75.0	32.5
	Total	1047.5	520.0	432.5	447.5	430.0	515.0	132.5	92.5	47.5	110.0	62.5

Considering the results, the following dissipation behaviour could be calculated. In model fit A the 277 DAT value of endosulfan-sulfate was included, in model fit B the 277 DAT was not considered, based on this different data sets the DT50 values were calculated. Endosulfan sulfate is derived from α and β -endosulfan and was therefore evaluated with TopFit 2.0, a multicompartiment kinetic model, in order to determine a true degradation half-life (figure 8.1.2.2-1).

Figure 8.1.2.2-1: Top Fit Compartment model schematic



The results of the Top Fit compartment model are showed in table 8.1.2.2-2 and table 8.1.2.2-3

Table 8.1.2.2-2: TopFit compartment model output (Model fit A)

		$K_{ij} (d^{-1})$	DT50 (d)	r^2
α -endosulfan	Σk_{ij}	0.345	2.0	0.833
	k_{13}	0.02	-	-
	k_{14}	0.325	-	-
β -endosulfan	Σk_{ij}	0.0488	14.2	0.810
	k_{23}	0.0114	-	-
	k_{24}	0.0374	-	-

Endosulfan sulfate	Σk_{ij}	0.00430	161	0.873
	k_{34}	0.00430	-	-
All data sets	-	-	-	0.839

Table 8.1.2.2-3: TopFit compartment model output (Model fit B)

		$K_{ij} (d^{-1})$	DT50 (d)	r^2
α -endosulfan	Σk_{ij}	0.3796	1.8	0.834
	k_{13}	0.00461	-	-
	k_{14}	0.375	-	-
β -endosulfan	Σk_{ij}	0.0436	15.9	0.813
	k_{23}	0.0256	-	-
	k_{24}	0.0180	-	-
Endosulfan sulfate	Σk_{ij}	0.0148	46.8	0.920
	k_{34}	0.0148	-	-
All data sets	-	-	-	0.856

Evaluation and comments: RMS considers more appropriate to use the results of the model fit A in which all the data set were included. Endosulfan rapidly dissipated under field conditions with a DT50 of 2 days for α -endosulfan and 14 days for β -endosulfan. Depending on the evaluation method used, the DT50 for endosulfan-sulfate ranged between 47 and 161 days, but the RMS considers more appropriate to use the DT50 = 161 days from the model fitted A. Total endosulfan-sulfate residues remained less than 10 %, at maximum of applied amount. α -, β -endosulfan completely disappeared 2 months after application while residues of endosulfan-sulfate were still present after 12 months in concentrations very close to the LOQ of 0.01 mg/kg. As the concentration over the whole period was only slightly above the LOQ, the results of the kinetic modelling are influenced by a high element of uncertainty.

According to the Topfit compartment analysis one can say that the contribution of the degradation of α - β -endosulfan to the formation of endosulfan sulfate was lower than their contribution to the unknown compartment, since the degradation kinetic constants k_{14} and k_{24} were higher than k_{13} and k_{23} .

α -, β -Endosulfan and endosulfan-sulfate were found to have low mobility under field conditions despite precipitation plus irrigation exceeded average annual rainfall by 4.6 %. Residues were found only occasionally below 10 cm in concentrations > LOQ demonstrating a low leaching potential and a negligible risk of groundwater contamination.

B.8.1.3 Overall assessment of the route and rate of degradation

In this section an overall assessment of the route and rate of endosulfan is included. We have included the conclusions of the studies assessed in the monograph and the three new studies.

- **Aerobic degradation**

Endosulfan aerobic degradation route and rate has been studied by Stumpf *et al*, 1995 (A53618); Gildemeister and Jordan, 1984 (A29680) and Stumpf, 1988 (A39424) in a variety of different soils (predominantly sandy loam and loamy sand soils) at different temperatures (21, 22 and 28°C) and application rates \geq than those recommended by GAP.

Results showed that aerobic degradation occurred via oxidation. In all studies, α endosulfan degraded quickly than the isomer β endosulfan. The main metabolite formed was endosulfan sulphate at a rate higher than 10% of applied radioactivity (18-40% at 60 days (Gildemeister and Jordan, 1984 (A29680)) and 46.1% at 365 days (Stumpf *et al*, 1995 (A53618))). This compound was slowly degraded to the more polar metabolites endosulfan diol, endosulfan lacton, endosulfan ether and other unknown compounds which appeared at <10% of applied radioactivity in all studies. Non-extractable residues were lower than 50% of applied radioactivity during the assay time 60 days (Gildemeister and Jordan, 1984 (A29680)) and lower than 25% of applied radioactivity at 100 days (Stumpf *et al*, 1995 (A53618))).

The CO₂ production was not properly measured in any of the studies, in some studies all the volatiles were measured and with this results the mineralization of endosulfan is expected to be low (<5%).

The degradation rate of endosulfan in soil laboratory studies can be summarised as follows (table 8.1.3-1).

Table 8.1.3-1: Summary of DT₅₀ values (days) in soil from laboratory studies

COMPOUND	TEMPERATURE	DT ₅₀	DT ₉₀	R ²	N
α endosulfan	21-22°C	12	39	0.89	6
		39	128	0.96	8
		19	63	0.89	8
		14	46	0.93	6
	28	23	78	0.80	4
β endosulfan	21-22°C	158	523	0.92	11
		264	877	0.92	13
		132	440	0.91	13
		108	357	0.84	8
	115	383	0.92	11	
28	58	194	0.99	4	
Parent compound	21-22°C	98	326	0.77	12
		128	426	0.90	13
		90	299	0.90	13
		92	305	0.71	8
		80	265	0.84	11
		27	85	0.96	8
	37.5	124.7	0.57	8	
28	37	123	0.92	4	

The lowest DT₅₀ and DT₉₀ values were observed at the highest temperatures (28±2°C) showing a direct relationship. DT₅₀ and DT₉₀ values for endosulfan sulphate were not established in any study due to linear equations could not be fit from the laboratory data at the assay time (365 days for the longest study). The DT₅₀ and DT₉₀ values of endosulfan sulphate were required (points 2.1 and 2.2 of the evaluation tables). In 2002 the notifier submitted an aerobic soil degradation study of endosulfan sulfate.

The study (Schnöder, 2002, C019647) showed that endosulfan sulfate, is subject to a moderate, but complete degradation accompanied by a significant formation of carbon dioxide. The DT50 of endosulfan sulfate was calculated in a range of 123 – 391 days, the mineralisation at 120 days was in a range of 1.01 - 13.08%. The bounded residues were < 70%. The results are showed in table 8.1.3-2.

Table 8.1.3-2: DT50 and DT 90 values of endosulfan sulfate according first order kinetics

Soil	LS2.2	SLS	SP	HE
DT ₅₀ (days)	123	141	391	147
DT ₉₀ (days)	409	468	1299	489
R ²	0.97	0.92	0.93	0.98

The previous assays, included in the monograph, demonstrated that the mineralisation of endosulfan were below 5%. The mineralisation of endosulfan sulfate is in line with the mineralisation of endosulfan. Based on the results of the previous studies and the result of the endosulfan sulfate aerobic degradation study it can be said that endosulfan is degrade to endosulfan sulfate and the mineralisation of endosulfan sulfate at 120 days is in a range of 1.01 – 13.08% and at 365 days is in a range of 5 – 35% depending on the type of soil. However, none of the metabolites detected and identified in previous assays (included in the monograph) were detected in this study. However there is an unknown

metabolite that appeared at level above 10% AR, all the attempts made for the identification of this metabolite failed but as a likely structure, a dicarboxylic acid, dihydrodiol metabolite is suspected. **The identification of this metabolite is essential for the definition of the degradation route of endosulfan, for the residue definition and for the field dissipation studies requiered. Furthermore in the field dissipation studies included in the monograph the endosufal diol was detected. The aerobic soil degradation study does not allow to produce a reliable DT50 and mineralisation of metabolites, furthermore an unknown metabolite was detected at levels higher than 10% of AR.**

- **Field studies**

Field degradation studies were conducted in Northern Europe, Southern Europe and in the United States (in climates comparable to Southern Europe). Three type of studies have been presented:

- Soil dissipation studies

- Soil residue studies

- Soil accumulation studies

All of them have been carried out with the formulate substance Thiodan 35 EC.

- **Field dissipation studies.**

Different studies under Northern conditions have been carried out by Baetel *et al.*, (A53554 and A54025) on silty loam, sandy silty loam, loamy sand and sandy loam soils at single application rates higher than those recommended by GAP, and for more than one year. DT₅₀ and DT₉₀ values from these studies (table 8.1.3-3).

Total endosulfan residues were found in the upper soil layer (0-20 cm). A relevant metabolite (endosulfan sulphate) was identified in all soil tested. It was accounted for >10% of applied concentration one year after application in three of these studies.

Under Southern conditions, three field dissipation studies have been presented (Hacker, 1989 (A42193); Mester, 1990 (A42997) and Czarnecki *et al.*, 1992 (A51819)). These studies were performed on different soil types at application rates higher than those established by GAP and covering multiple endosulfan applications (2 or 5 per year). DT₅₀ values presented by Hacker (A42193) and Mester (A42997) were estimated from endosulfan concentrations before the last application, it is considered that these studies represented worst field conditions, regarding application rate and number of applications. In all the studies it can be observed that the concentration of $\alpha+\beta$ Endosulfan in soil before the last application was <0.05 mg/kg, therefore all the studies are considered valid . **The calculation of the DT₅₀ of endosulfan sulphate was considered irrelevant in all the studies since both processes (formation and disapearence) were not considered together in the calculation.**

On March 2002 the notifier submitted two new soil dissipation studies under southern conditions. The studies were performed in Spain (Hardy 2001, C015651) and Greece (Balluff, 2001, C018180). A nominal application rate of 840 g a.i./ha was made in bothe studies. Soil samples from different depths

to a maximum of 0.3 m below the surface were then collected at regular intervals over 9 months and analysed for α -endosulfan, β -endosulfan and endosulfan sulphate. The resulting parent compound residue decay rate versus days after application was evaluated by a pesticide dissipation model (ModelManager), with endosulfan sulfate being evaluated using multicompartment kinetic model (TopFit) to determine a degradation half life. The results of both studies showed that Endosulfan rapidly dissipated under field conditions. α -endosulfan (DT50 1.4 – 2.0 days) disappeared more rapidly than β -endosulfan (DT50 7.9 – 14.2 days), with total parent endosulfan ($\alpha+\beta$) residues also declining rapidly (DT50 2.5 days). Total parent endosulfan residues were less than 10 % of applied within 1 month. The soil metabolite endosulfan sulfate achieved a maximum residue of 7.5 % of applied parent at 14 days in the Spanish study and 13.4% at 28 days in the Greece study and then declined (DT50 75.2 – 161 days) to leave no detectable residues after 6 months. As the concentration over the whole period was only slightly above the LOQ, the results of the kinetic modelling are influenced by a high element of uncertainty.

According to the Topfit compartment analysis one can say that the contribution of the degradation of α - β -endosulfan to the formation of endosulfan sulfate was lower than their contribution to the unknown compartment, since the degradation kinetic constants k_{14} and k_{24} were higher than k_{13} and k_{23} .

α -, β -Endosulfan and endosulfan sulfate were found to have low mobility under field conditions despite precipitation plus irrigation exceeding average local rainfall during the period of the study. No residues were found in the soil deeper than 10 cm, thus this field study demonstrates the low potential for unsaturated zone movement and negligible potential for α -, β -Endosulfan or endosulfan sulfate to appear in groundwater.

DT₅₀ for α - β - Endosulfan and endosulfan sulfate values were estimated after each application in cropped and bareground loamy sand soil (table 8.1.3-3).

Table 8.1.4-2: DT₅₀ ($\alpha+\beta$ Endosulfan) values (days) in soils under Southern conditions from field studies

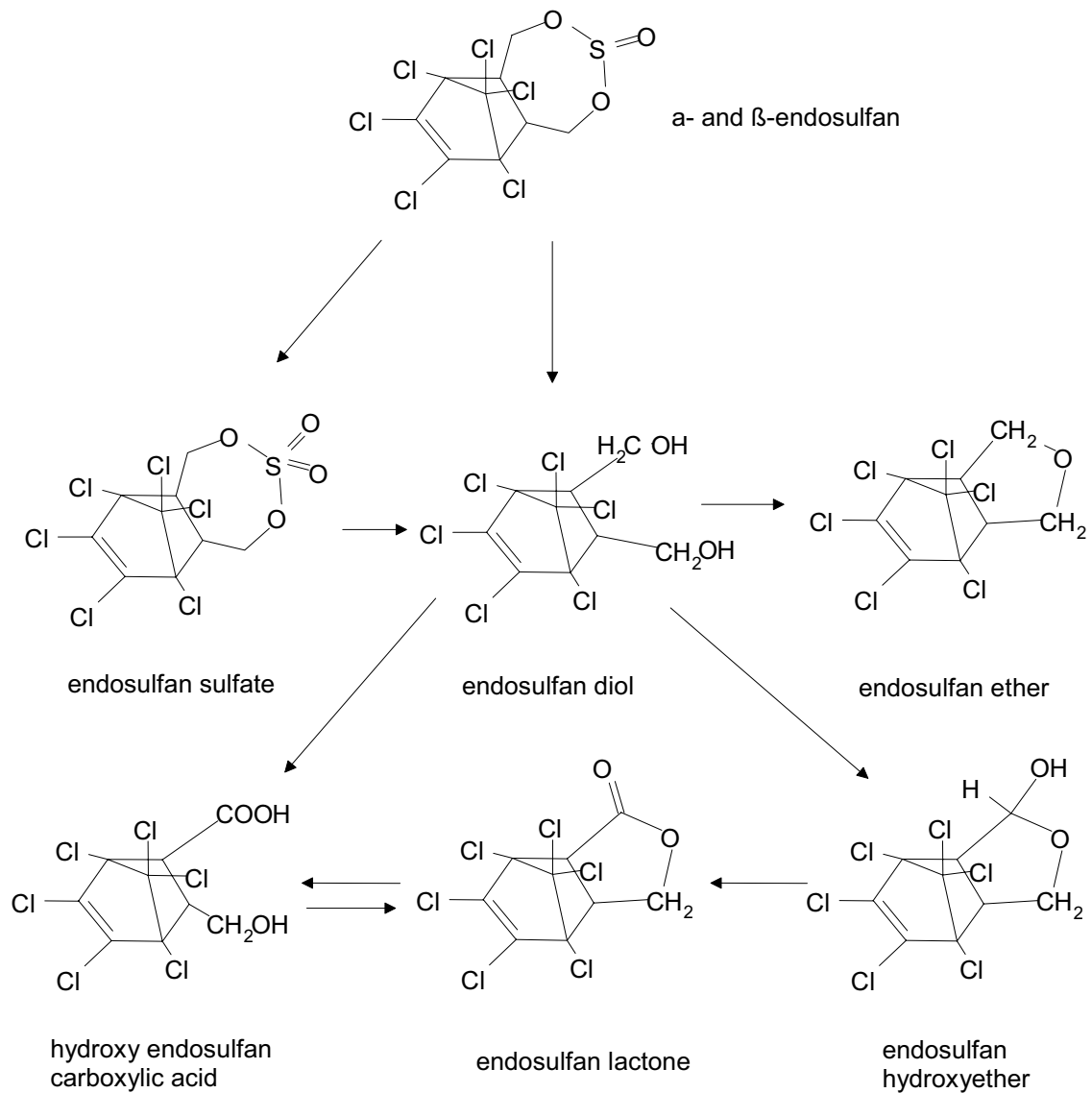
DT ₅₀ (days)	DT ₉₀ (days)	R ²	n	Kinetic	pH	Reference
$\alpha+\beta$ Endosulfan						
91.6	304.2	0.90	10	1 st order	7.1	A53554 Silty loam soil
35.9	395.9	0.64	8	Root 1 st order	5.2	A53554 Sandy silty soil
167.1	555.2	0.41	8	1 st order		
38.5	424.6	0.9	10	Root 1 st order	5.7	A54025 Loamy sand soil
123.7	410.9	0.57	10	1 st order		
16.5	181.8	0.76	10	Root 1 st order	5.6	A54025 Sandy loam soil
130.6	433.8	0.45	10	1 st order		
75.86	252.02	0.88	18	1 st order		A42193 Sandy loam (Crop)
89.6	297.7	0.86	18	1 st order		A42193 Sandy loam (Bareground)
92.9	308.8	0.89	13	1 st order	6.7	A42997 Clay loam (Crop)
89.5	297.5	0.82	13	1 st order		A42997 Clay loam (Bareground)
61.10	202.9	0.61	11	1 st order	6.8	A51819 Loamy sand (crop)
46.2	153.5	0.72	11	1 st order		A51819 Loamy sand (Bareground)
2.5	8.2	0.87	10	1 st order	6.2	C015651 Sandy silt loam (bareground)
α Endosulfan						
2.0		0.83	11	1 st order	7.7	C018180 Sandy silt (Bareground)
β Endosulfan						
14.2		0.81	11	1 st order	7.7	C018180 Sandy silt (Bareground)
Endosulfan sulfate						
75.2	249.7	0.89	10	1 st order	6.2	C015651 Sandy silt loam (bareground)
161		0.87	11	1 st order	7.7	C018180 Sandy silt (Bareground)

Soil residues were studied by Tiirma and Dorn, 1988 (A40218) in ten different soils after more than 3 years of use of formulated endosulfan. The maximum dosages per year were always higher than those proposed by GAP, from 0.5 to 3.2 kg as/ha. Monitoring was done 6 or 7 months after the last application. In all cases, even in areas where endosulfan was used intensively over several years, residues of parent endosulfan were lower than 10% of the applied concentration and there was no evidence of leaching. The crop conditions do not seem to influence dissipation of endosulfan. However, **residues of endosulfan sulphate (>10% of the initial concentration) were observed in some cases.**

Soil accumulation was studied by Tiirmaa et al, 1993 (A53771). Eighth year old apple trees were treated in a loamy clay soil with 12 applications at 1.5 kg as/ha each in 4 consecutive years. Total residue (parent compound plus endosulfan sulphate) was always lower than 10% of the applied concentration at the end of each year of use. So, accumulation from one year to another should not be expected. Even though, should be taken into account, that the main metabolite endosulfan sulphate was observed at more than 10% of the initial concentrations up to 200 days after the 3rd application. Its plateau concentration rose 20-50 % of the initial concentration 5 months before the end of the study.

In summarising the results from all relevant degradation studies in soil, the following degradation scheme is proposed.

The degradation of endosulfan in soil did not show any alteration of the hexachlor norbornene bicyclic and showed a very low mineralization (<5%). These two facts suggest a high persistence of a soil residue constituted by a number of chlorinated metabolites, which may not account individually for more than 10% of applied dose but that all together may represent high amount of it. Based on their chemical structure it may be expected that their physico chemical properties of these compound will be similar and generally persistent and bioaccumulable. Therefore, a wider investigation of the degradation routes of this compound must be done.



NO FURTHER DEGRADATION HAS BEEN DEMONSTRATED

B.8.11 References relied on

Annex IIA or Annex IIIA point	Author(s) Year Title Reference	GLP GEP Y / N	Published Y / N	Owner	Data Protection
	Schnöder, F 2002 [¹⁴ C]AE F051327: soil Metabolism and degradation Aventis CropScience USA LP. Doc. No.: C019647; Report No. 1651-1490-019	Y	N	Aventis	Y
	Balluff, M 2001 Field Soil Dissipation of AE F002671 (endosulfan) following a single application to bare (preemergence) cotton plots at 1 location in Greece, 2000 Aventis CropScience USA LP. Doc. No.: C018180; Report No. 20003033/GR1-FS	Y	N	Aventis	Y
	Hardy, I.A.JH 2001 Endosulfan field soil dissipation study in Spain Aventis CropScience USA LP. Doc. No.: C015651; Report No. 26644	Y	N	Aventis	Y

ADDENDUM TO ANNEX B

ENDOSULFAN

B - 9: ECOTOXICOLOGY

B.9.11 References relied on

Annex IIA or Annex IIIA point	Author(s) Year Title Reference	GLP GEP Y / N	Published Y / N	Owner	Data Protection
	Abedi, J.; Young, B. 2001a The 48 hour acute toxicity to the water Flea, Daphnia magna, in a Flow-Through System: AE F051328 (endosulfan lactone) sunstance, pure 96.7% w/w Aventis CropScience USA LP. Doc. No.: B003206; Report No. BJ00W516	Y	N	Aventis	Y
	Abedi, A.; Young, B. 2001b The 96 hour acute toxicity to the common carp, Cyprinus carpio, in a Flow-Through System AE F051326 (endosulfan hydroxyether) substance, Pure 96.7% w/w Aventis CropScience USA LP. Doc. No.: B003208; Report No. BJ00W519	Y	N	Aventis	Y
	Abedi, A.; Young, B. 2001c The 96 hour acute toxicity to the common carp, Cyprinus carpio, in a Static Renewal System AE F051326 (endosulfan hydroxyether) substance, Pure 95.7% w/w Aventis CropScience USA LP. Doc. No.: B003209; Report No. BJ00W521	Y	N	Aventis	Y
	Bremmer, J.N.; Leist, K.H. 1998 Evaluation of possible endocrine effects in mammalian species Endosulfan Hoechst Schering AgrEvo GmbH Doc. No. C001570; Report No. TOX98/046			Aventis	N
	Gries, T. 2000a Acute toxicity test with carp (Cyprinus carpio) under semistatic conditions ¹⁴ C-endosulfansulfat (Metabolite of ¹⁴ C-endosulfan) ██ Doc. No. C010869; Report No. 1049.014.170	Y	N	Aventis	Y
	Gries, Th.; van der Kolk, J. 2001a Acute toxicity test with carp (Cyprinus carpio) under semistatic conditions ¹⁴ C-Beta-Endosulfan ██ C012039; Report No. 1049.018.170	Y	N	Aventis	Y
	Gries, Th.; van der Kolk, J. 2001b Acute toxicity test with carp (Cyprinus carpio) under semistatic conditions ¹⁴ C-Alpha-Endosulfan ██ C012038; Report No. 1049.017.170	Y	N	Aventis	Y

Annex IIA or Annex IIIA point	Author(s) Year Title Reference	GLP GEP Y / N	Published Y / N	Owner	Data Protection
	Gries, Th. 2001a Acute immobilisation test with daphnids (Daphnia magna) under semi-static conditions ¹⁴ C-alfa-endosulfan Code: AE F052618 Springborn Laboratories (Europe) AG. Doc. No. C012048; Report No. 1049.017.110	Y	N	Aventis	Y
	Gries, Th. 2001b Acute immobilisation test with daphnids (Daphnia magna) under semi-static conditions ¹⁴ C-Beta-endosulfan Code: AE F052619 Springborn Laboratories (Europe) AG. Doc. No. C012047; Report No. 1049.018.110	Y	N	Aventis	Y
	Gries, Th. 2001a Acute immobilisation test with daphnids (Daphnia magna) under static conditions ¹⁴ C- endosulfansulfat (metabolite of ¹⁴ C-endosulfan) Springborn Laboratories (Europe) AG. Doc. No. C012413; Report No. 1049.014.110	Y	N	Aventis	Y
	Heusel, R. 1999 Evaluation of possible endocrine effects in fish Endosulfan Code: AE F002671 [REDACTED] Doc. No. C004471; Report No. OE99/010			Aventis	N
	Knaebe, S. 2001 An evaluation of the effects of endosulfan (AE F002671 00 EC33 C703) on the non-target arthropod fauna in a citrus orchard in Sapin Arbeitsgemeinsch. GAB GmbH & IFU GmbH. Doc. No. C012888; Report No. 20001050/S1- FNTO			Aventis	N
	Madsen, T.; Leak, T. 2001a Metabolite of pesticide Endosulfan, to the common carp, Cyprinus carpio, determined under Flow-Through Test conditions [REDACTED] B003100; Report No. 46289	Y	N	Aventis	Y
	Madsen, T.; Leak, T. 2001b Acute toxicity of AE F051330 (Endosulfan ether), a metabolite of the pesticide Endosulfan, to the Water Flea, Daphnia magna, determined under Flow-Through Test conditions ABC Laboratories, Inc. Doc. No.: B003099; Report No. 46288	Y	N	Aventis	Y

Annex IIA or Annex IIIA point	Author(s) Year Title Reference	GLP GEP Y / N	Published Y / N	Owner	Data Protection
	Schur, A. 2000 Assessment of side effects of AE F002671 00 EC33 C703 on the honey bee (<i>Apis mellifera</i> L.) in the field following application during bee- flight in Spain Arbeitsgemeinschaft GAB GmbH & IFU GmbH. Doc. No. C010572; Report No. 20001050/S1- BFEU			Aventis	N
	Williams, T.D.; Caunter, J.E. 1999 Effect on the survival, weight, length and vitellogenin concentration of juvenile fathead minnow (<i>Pimephales promelas</i>) Endosulfan substance technical Code: AE F002671 00 1D99 0008 [REDACTED] Doc. No. C006997; Report No. BL6664/B	Y	N	Aventis	Y

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