UNITED NATIONS

Food and Agriculture Organization of the United Nations

RC

UNEP/FAO/RC/COP.8/15/Add.1

Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade

Distr.: General
26 October 2016

Original: English

Conference of the Parties to the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade
Eighth meeting
Geneva, 24 April–5 May 2017
Item 5 (b) (i) of the provisional agenda*

Matters related to the implementation of the Convention: listing of chemicals in Annex III to the Convention: consideration of chemicals for inclusion in Annex III

Inclusion of carbosulfan in Annex III to the Rotterdam Convention

Addendum

Draft decision guidance document

Note by the Secretariat

As referred to in document UNEP/FAO/RC/COP.8/15, at its twelfth meeting, in its decision CRC-12/2, the Chemical Review Committee adopted a draft decision guidance document on carbosulfan. The draft decision guidance document is set out in the annex to the present note for the consideration of the Conference of the Parties. It has not been formally edited.

* UNEP/FAO/RC/COP.8/1.

Annex

Rotterdam Convention

Operation of the Prior Informed Consent Procedure
for Banned or Severely Restricted Chemicals

Draft Decision Guidance Document

Carbosulfan

Secretariat of the Rotterdam Convention
on the Prior Informed Consent Procedure
for Certain Hazardous Chemicals and Pesticides
in International Trade

Food and Agriculture
Organization of the
United Nations

UNEP

Introduction

The objective of the Rotterdam Convention is to promote shared responsibility and cooperative efforts among Parties in the international trade of certain hazardous chemicals in order to protect human health and the environment from potential harm and to contribute to their environmentally sound use, by facilitating information exchange about their characteristics, by providing for a national decision-making process on their import and export and by disseminating these decisions to Parties. The Secretariat of the Convention is provided jointly by the United Nations Environment Programme (UNEP) and the Food and Agriculture Organization of the United Nations (FAO).

Candidate chemicals[1] for inclusion in the prior informed consent (PIC) procedure under the Rotterdam Convention include those that have been banned or severely restricted by national regulatory actions in two or more Parties[2] in two or more different regions. Inclusion of a chemical in the PIC procedure is based on regulatory actions taken by Parties that have addressed the risks associated with the chemical by banning or severely restricting it. Other ways might be available to control or reduce such risks. Inclusion does not, however, imply that all Parties to the Convention have banned or severely restricted the chemical. For each chemical included in Annex III of the Rotterdam Convention and subject to the PIC procedure, Parties are requested to make an informed decision whether they consent or not to the future import of the chemical.

At its […] meeting, held in […] on […], the Conference of the Parties agreed to list [chemical name] in Annex III of the Convention and adopted the decision-guidance document with the effect that this group of chemicals became subject to the PIC procedure.

The present decision-guidance document was communicated to designated national authorities on […], in accordance with Articles 7 and 10 of the Rotterdam Convention.

Purpose of the decision guidance document

For each chemical included in Annex III of the Rotterdam Convention, a decision-guidance document has been approved by the Conference of the Parties. Decision-guidance documents are sent to all Parties with a request that they make a decision regarding future import of the chemical.

Decision-guidance documents are prepared by the Chemical Review Committee. The Committee is a group of government-designated experts established in line with Article 18 of the Convention, which evaluates candidate chemicals for possible inclusion in Annex III of the Convention. Decision-guidance documents reflect the information provided by two or more Parties in support of their national regulatory actions to ban or severely restrict the chemical. They are not intended as the only source of information on a chemical nor are they updated or revised following their adoption by the Conference of the Parties.

There may be additional Parties that have taken regulatory actions to ban or severely restrict the chemical and others that have not banned or severely restricted it. Risk evaluations or information on alternative risk mitigation measures submitted by such Parties may be found on the Rotterdam Convention website (www.pic.int).

Under Article 14 of the Convention, Parties can exchange scientific, technical, economic and legal information concerning the chemicals under the scope of the Convention including toxicological, ecotoxicological and safety information. This information may be provided directly to other Parties or through the Secretariat. Information provided to the Secretariat will be posted on the Rotterdam Convention website.

Information on the chemical may also be available from other sources.

Disclaimer

The use of trade names in the present document is primarily intended to facilitate the correct identification of the chemical. It is not intended to imply any approval or disapproval of any particular company. As it is not possible to include all trade names presently in use, only a number of commonly used and published trade names have been included in the document.

[1] According to the Convention, the term "chemical" means a substance, whether by itself or in a mixture or preparation and whether manufactured or obtained from nature, but does not include any living organism. It consists of the following categories: pesticide (including severely hazardous pesticide formulations) and industrial.

[2] According to the Convention, the term "Party" means a State or regional economic integration organization that has consented to be bound by the Convention and for which the Convention is in force.

While the information provided is believed to be accurate according to data available at the time of preparation of the present decision-guidance document, FAO and UNEP disclaim any responsibility for omissions or any consequences that may arise there from. Neither FAO nor UNEP shall be liable for any injury, loss, damage or prejudice of any kind that may be suffered as a result of importing or prohibiting the import of this chemical.

The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of FAO or UNEP concerning the legal status of any country, territory, city or area or of its authorities or concerning the delimitation of its frontiers or boundaries.

Standard core set of abbreviations[3]

STANDARD CORE SET OF ABBREVIATIONS	
<	less than
≤	less than or equal to
>	greater than
≥	greater than or equal to
µg	microgram
AR	applied radioactivity
ARfD	acute reference dose
a.s.	active substance
ADI	acceptable daily intake
AOEL	acceptable operator exposure level
b.p.	boiling point
bw	body weight
^{o}C	degree Celsius (centigrade)
CA	Chemical Abstracts
CAS	Chemical Abstracts Service
cm	centimetre
DT_{50}	dissipation time 50%
d.w.	dry weight
EAC	Ecologically Acceptable Concentration
EC	European Community
EC_{50}	median effective concentration
E_bC_{50}	Concentration of test substance which results in a 50% reduction in growth relative to the control
E_rC_{50}	Concentration of test substance which results in a 50% reduction in growth rate relative to the control
ED_{50}	median effective dose
EEC	European Economic Community
EFSA	European Food Safety Authority
EHC	Environmental Health Criteria
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
g	gram
h	hour
ha	hectare
IRAC	Insecticide Resistance Classification
IARC	International Agency for Research on Cancer
IC_{50}	median inhibitory concentration
IPCS	International Programme on Chemical Safety
IPM	Integrated Pest Management
IUPAC	International Union of Pure and Applied Chemistry

[3] *This core list should serve as the basis for DGDs for industrial chemicals, pesticides and severely hazardous pesticide formulations. It should be augmented by abbreviations used in the individual DGDs relevant to the chemical(s) in question.*

Definitions and spelling should, as far as practicable, follow the IUPAC glossary of terms in toxicology and the IUPAC glossary of terms relating to pesticides in their current editions.

As a general rule it is preferable that acronyms used only once in the text be spelled out rather than included in the list of abbreviations.

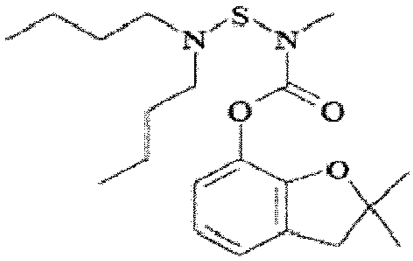
STANDARD CORE SET OF ABBREVIATIONS

JMPR	Joint FAO/WHO Meeting on Pesticide Residues (Joint Meeting of the FAO Panel of Experts on Pesticide Residues in Food and the Environment and a WHO Expert Group on Pesticide Residues)
k	kilo- (x 1000)
kg	kilogram
K_{FOC}	Organic carbon normalized Freundlich adsorption coefficient
Koc	soil organic partition coefficient.
Kow	octanol–water partition coefficient
L	litre
LC_{50}	median lethal concentration
LD_{50}	median lethal dose
LOAEL	lowest-observed-adverse-effect level
LOEL	Lowest-observed-effect level
LOQ	Level of quantification
m	metre
m.p.	melting point
mg	milligram
ml	millilitre
MRL	maximum residue limit
MWHC	Maximum water holding capacity
ng	nanogram
NOAEC	no-observed-adverse-effect concentration
NOAEL	no-observed-adverse-effect level
NOEC	no-observed-effect concentration
NOEL	no-observed-effect level
OC	Organic Carbon
PEC	predicted environmental concentration
Pow	octanol-water partition coefficient, also referred to as Kow
PPE	personal protective equipment
PPDB	Pesticide Properties Database
ppm	parts per million (used only with reference to the concentration of a pesticide in an experimental diet. In all other contexts the terms mg/kg or mg/L are used).
RfD	reference dose (for chronic oral exposure; comparable to ADI)
RMS	Rapporteur Member State
SMILES	Simplified Molecular Input Line Entry Specifications
SPC	Sahelian Pesticide Committee
TER	toxicity exposure ratio
UNEP	United Nations Environment Programme
US EPA	United States Environmental Protection Agency
w/w	weight for weight
WHO	World Health Organization
wt	weight

Decision guidance document for a banned or severely restricted chemical

Carbosulfan **Published: [Date]**

1. Identification and uses (see Annex 1 for further details)

Common name	Carbosulfan
Chemical name and other names or synonyms	IUPAC: 2,3-dihydro-2,2-dimethylbenzofuran-7-yl(dibutylaminothio)methylcarbamate CA: 2, 3-dihydro-2, 2-dimethyl-7-benzofuranyl[(dibutylamino)thio]methylcarbamate
Molecular formula	$C_{20}H_{32}N_2O_3S$
Chemical structure	
CAS-No.(s)	55285-14-8
Harmonized System Customs Code	2932 99 3808.9190
Other numbers	EINECS: 259-565-9 CIPAC No: 417 Combined Nomenclature (CN) code of the European Union: 2932 99 00 UN Number: 2992
Category	Pesticide
Regulated category	Pesticide
Use(s) in regulated category	According to the European Union (EU) notification, carbosulfan was used by incorporation into soil (at drilling) to control soil insects, where maize and sugar beet were grown. It was also used on citrus and cotton. Carbosulfan can be used as insecticide and nematicide. According to the notifications from Burkina Faso, Cabo Verde, Chad, the Gambia, Mauritania, the Niger, Senegal and Togo (hereafter referred to as the CILSS countries), carbosulfan had uses as an insecticide-nematicide. No information was reported for crop, application rates or application methods.
Trade names	Trade names from the EU notification: Marshal 10G (GR); Marshal 25CS; Marshal 25 EC (UNEP/FAO/RC/CRC.11/7) Trade names from the notifications from CILSS countries: PROCOT 40 WS (Section 1.3, page 92, UNEP/FAO/RC/CRC.11/7); Posse 10G, Marshal 10G, Advantage (UNEP/FAO/RC/CRC.11/INF/15.En, PPDB (2014), p3) *This is an indicative list. It is not intended to be exhaustive.*
Formulation types	Usually supplied as dry granules applied directly to soil or seed bed; also used in foliar applications. (UNEP/FAO/RC/CRC.11/INF/15.En, PPDB (2014), p3) (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2006), p4)
Uses in other categories	There is no reported use as an industrial chemical.
Basic manufacturers	Belchim, Fargro, Agrinoon Enterprise Limited (UNEP/FAO/RC/CRC.11/INF/15.En, PPDB (2014), p3) *This is an indicative list of current and former manufacturers. It is not intended to be exhaustive.*

2. Reasons for inclusion in the PIC procedure

Carbosulfan is included in the PIC procedure as a pesticide. It is listed on the basis of the final regulatory actions taken by the EU and CILSS countries to ban carbosulfan as a pesticide. No final regulatory actions relating to industrial chemical uses of carbosulfan have been notified.

2.1 Final regulatory action (see Annex 2 for further details)

European Union

It is prohibited to place on the market or use plant protection products containing carbosulfan. Carbosulfan is not included in the list of approved active substances under Regulation (EC) No 1107/2009, which replaces Directive 91/414/EEC. Authorisations for plant protection products containing carbosulfan had to be withdrawn by 13 December 2007. As of 16 June 2007 no authorisations for plant protection products containing carbosulfan were allowed to be granted or renewed by the Member States and all uses of plant protection products containing carbosulfan were prohibited as from 13 December 2008 (UNEP/FAO/RC/CRC.11/7).

Reason: Human Health and the Environment

CILSS countries

All products containing Carbosulfan are banned due to their extremely high toxic potential to human health and especially the environment (UNEP/FAO/RC/CRC.11/7). On recommendation of the Sahelian Pesticide Committee (SPC), Carbosulfan has been banned by decision of CILSS Coordinating Minister N007/MAE-MC/2015 of 8th April 2015 (UNEP/FAO/RC/CRC.11/7).

Reason: Human Health and the Environment

2.2 Risk evaluation (see Annex 1 for further details)

European Union

Human health

It was concluded that carbosulfan was not demonstrated to fulfil the safety requirements laid down in Article 5 (1) (a) and (b) of Directive 91/414/EEC.

Certain metabolites with a hazardous profile appear with the use of carbosulfan. Some of these metabolites could be genotoxic. Due to uncertainties on this issue, and based on the current knowledge and the available data, risks regarding the exposure of consumers could not be excluded.

In addition, impurities, of which at least one is carcinogenic (N-nitrosodibutylamine), were found in the substance as sold in the market (technical substance) at levels raising concerns, however a new specification submitted during a resubmission indicated this substance no longer exceeded the limit of 1mg/kg and concerns over this impurity could be considered as addressed (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2009), p13).

The further review in 2009 noted a possible exceedance of the Acceptable Daily Intake by toddlers and an acute risk to children and adults from consumption of a number of crops. (UNEP/FAO/RC/CRC.11/7)

Environment

It was concluded that carbosulfan was not demonstrated to fulfil the safety requirements laid down in Article 5 (1) (a) and (b) of Directive 91/414/EEC.

The evaluation raised concerns regarding a possible risk to groundwater, due to a potential contamination of groundwater by the parent substance and by a number of relevant metabolites.

In addition, the risk to birds and mammals, aquatic organisms, bees and earthworms could not be sufficiently assessed due to a lack of substantial data. Therefore, concerns remain as regards the risk assessment for these species. Additional data were available in the 2009 review which allowed addressing further elements of the risk assessment. There was a risk to birds and mammals from the uptake of residues in contaminated food items. Carbosulfan is toxic to bees and non-target arthropods although the risk was considered low for the representative uses that were evaluated. The risk to aquatic organisms, soil microorganisms and plants was considered low for the representative uses that were evaluated. (UNEP/FAO/RC/CRC.11/7)

<u>CILSS countries</u>

Human health

The Sahelian Pesticides Committee stopped the registration of carbosulfan based pesticides in 2006 taking into account the following reasons (UNEP/FAO/RC/CRC.11/INF/15.En, SPC (2014), p5):

a) The fragile ecology of CILSS countries already characterised by an imbalance of ecosystems and the disappearance of organisms useful to the environment;

b) Non-compliance with recommended measures for a safe use of carbosulfan by users in the context of CILSS countries;

c) The low utilisation rate of protective equipment by growers;

d) The existence of alternatives to the use of carbosulfan.

In the notifications, the following hazards to human health are reported: carbosulfan belongs to WHO Class II (moderately hazardous) (Footprint, 2011; WHO, 2008); it is a cholinesterase inhibitor (FAO, 2003). Furthermore, the notification states that during a pilot study carried out in Burkina Faso in June 2010, through both retrospective and prospective surveys, one carbosulfan based formulation was involved in a poisoning case: PROCOT 40 WS, a tertiary formulation containing carbosulfan (250 g/kg), carbendazim (100 g/kg) and metalaxyl-M (50 g/kg).

The Annex to the decision to ban carbosulfan further specifies the risks to human health and the environment in the notifying Parties. These risks result from pesticide use in general but also explicitly apply to the use of pesticides containing carbosulfan. Growers do not follow Good Agricultural Practices, in particular the use of appropriate personal protective equipment. Protective equipment (dust masks, boots and gloves in particular) is sold to the growers by distributors in 20% of cases. That equipment is not specific for field treatments. Growers mainly wear dust masks (39.08 % of cases) followed by boots (28.8 %) whereas overalls are the least used (4.5 %) during plant treatment (UNEP/FAO/RC/CRC.11/INF/15.En, SPC (2014), p4).

More than half of the growers (67.5 %) had a water source in their fields or nearby. The majority of water points were less than 100m from the fields and this proximity may be at the origin of water pollution by pesticides. Water was drunk in 50% of cases, it was used for the preparation or dilution of pesticides in 29.26 % and used for animal drinking in 26.96 % (UNEP/FAO/RC/CRC.11/INF/15.En, SPC (2014), p4).

Environment

Carbosulfan is highly toxic to birds (LD_{50} *Anas platyrhynchos* = 10 mg/kg), fish (LC_{50} 96h *Lepomis macrochirus* = 0.015 mg/L), aquatic invertebrates (EC_{50} 48h *Daphnia magna* = 0.0032 mg/L) and bees (LD_{50} 48h = 0.18 μg/bee). (UNEP/FAO/RC/CRC.11/7)

In April 2015, on recommendation of the Sahelian Pesticides Committee, carbosulfan was banned by decision of the CILSS Coordinating Minister (Minister of Agriculture and Environment) due to unacceptable risk to the human health (difficulty to handle carbosulfan by users from Sahel Countries without risks) and non-target organisms in the environment (UNEP/FAO/RC/CRC.11/INF/15.En, SPC (2014), p5). The ban of carbosulfan in several other countries such as the EU is also mentioned (UNEP/FAO/RC/CRC.11/INF/15.En, SPC (2014), p3).

3. Protective measures that have been applied concerning the chemical

3.1 Regulatory measures to reduce exposure

<u>European Union</u>	The regulatory action was a ban on the use of carbosulfan. There were no other regulatory measures introduced with this regulatory action to reduce exposure.
<u>CILSS countries</u>	The regulatory action was a ban on the use of carbosulfan. There were no other regulatory measures introduced with this regulatory action to reduce exposure.

3.2 Other measures to reduce exposure

<u>European Union</u>

None reported – none required since all uses of plant protection products containing carbosulfan were prohibited in the EU.

<u>CILSS countries</u>

None reported – none required since carbosulfan products can no longer be used in the CILSS countries.

3.3 Alternatives

It is essential that before a country considers alternatives to carbosulfan, it ensures that the use is relevant to its national needs, and the anticipated local conditions of use. The hazards of the substitute materials and the controls needed for safe use should also be evaluated.

European Union

No information on alternatives was reported.

CILSS countries

Alternatives to the use of carbosulfan-based formulations do exist. As an alternative, there are insecticide/acaricide formulations which are registered and authorized for sale in CILSS countries. There are at least ten insecticide/acaricide formulations in the general list of pesticides registered by SPC for corn, sugar cane, vegetables (SPC, 2014). These are chlorpyrifos-5 ethyl, profenofos, cypermethrin, ethoprophos, abamectin, deltamethrin and lambda-cyhalothrin based formulations. (UNEP/FAO/RC/CRC.11/7)

General

There are a number of alternative methods involving chemical and non-chemical strategies, including alternative technologies available, depending on the individual crop-pest complex under consideration. Countries should consider promoting, as appropriate, integrated pest management (IPM), agroecology, and application of organic agriculture as a means of reducing or eliminating the use of hazardous pesticides.

Advice may be available through National IPM focal points, the FAO, IFOAM (International Federation of Organic Movements), and agricultural research or development agencies. Where it has been made available by governments, additional information on alternatives to carbosulfan may be found on the Rotterdam Convention website www.pic.int.

3.4 Socio-economic effects

European Union

No information on socio-economic effects was provided.

CILSS countries

No information on socio-economic effects was provided.

4. Hazards and Risks to human health and the environment

4.1 Hazard Classification

WHO / IPCS	Moderately hazardous (Class II).
IRAC	Group 1 Acetylcholinesterase (AChE) inhibitors, 1A Carbamates
European Community	Classification of the EU in accordance with Council Directive 67/548/EEC: T+ - Very toxic. R26 – Very toxic by inhalation. R25 – Toxic if swallowed. R43 – May cause sensitization by skin contact. N – Dangerous for the environment. R50/53 – Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. Classification of the EU according to Regulation (EC) No 1272/2008, which implements the UN GHS in the European Union: Acute Tox. 2 * - H330 – Fatal if inhaled. Acute Tox. 3 * - H302 – Toxic if swallowed. Skin Sens. 1 – H317 – May cause an allergic skin reaction. Aquatic Acute 1 – H400 – Very toxic to aquatic life. Aquatic Chronic 1 – H410 – Very toxic to aquatic life with long lasting effects. * = This classification shall be considered as a minimum classification.

4.2 Exposure limits

European Union

Acceptable Daily Intake (ADI): 0.005 mg/kg bw/day (based on rat neurotoxicity study with 100 Safety Factor)
Acceptable Operator Exposure Level (AOEL): 0.005 mg/kg bw/day (based on rat neurotoxicity study with 100 Safety Factor)
Acute Reference Dose (ARfD): 0.005 mg/kg bw (based on rat neurotoxicity study with 100 Safety Factor)
(UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2009), p2)

Safety Values at the time when the regulatory action was taken in the EU:
Acceptable Daily Intake (ADI): 0.01 mg/kg bw/day (based on rat 2-year study with 100 Safety Factor)
Acceptable Operator Exposure Level (AOEL): 0.02 mg/kg bw/day (based on rat 90- day study with 100 Safety Factor)
Acute Reference Dose (ARfD): 0.01 mg/kg bw/day (based on rat 2-year study with 100 Safety Factor)
(UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2006), p2)

Proposed MRLs:
Separate MRLs for carbosulfan and carbofuran have been proposed resulting from the uses of carbosulfan in sugar beets
Carbosulfan 0.005 * mg/kg
Carbofuran: For the time being no MRLs can be proposed.
(UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2009), p25)

CILSS countries

Acceptable Daily Intake (ADI): 0.005 mg/kg bw/day
Acceptable Operator Exposure Level (AOEL): 0.005 mg/kg bw/day
Acute Reference Dose (ARfD): 0.005 mg/kg bw

(UNEP/FAO/RC/CRC.11/INF/15.En, PPDB (2014), p9)

As far as toxicity to human health is concerned, the acceptable daily intake (ADI) is around: 0.01 mg/kg bw/day. (UNEP/FAO/RC/CRC.11/INF/15.En, Wikipedia, p133)

The following have been obtained from the **CODEX Pesticide Residues in Food and Feed Online database** available at: http://www.fao.org/fao-who-codexalimentarius/standards/pestres/pesticide-detail/en/?p_id=145

Pesticide Residues in Food and Feed - Pesticide Details:
145 Carbosulfan
Functional Class: Insecticide
Maximum Residue Limits for Carbosulfan

Commodity	MRL	Year of Adoption	Symbols	Note
Citrus pulp, Dry	0.1 mg/kg	2005		
Cotton seed	0.05 mg/kg	2005		
Edible offal (mammalian)	0.05 mg/kg	2005	(*)	
Eggs	0.05 mg/kg	2005	(*)	
Maize	0.05 mg/kg	2005	(*)	
Mandarin	0.1 mg/kg	2010		
Meat (from mammals other than marine mammals)	0.05 mg/kg	2005	(*) (fat)	
Oranges, Sweet, Sour (including Orange-like hybrids): several cultivars	0.1 mg/kg	2010		
Poultry meat	0.05 mg/kg	2005	(*)	
Poultry, Edible offal of	0.05 mg/kg	2005	(*)	
Rice straw and fodder, Dry	0.05 mg/kg	2005	(*)	
Spices, Fruits and Berries	0.07 mg/kg	2011		
Spices, Roots and Rhizomes	0.1 mg/kg	2011		
Sugar beet	0.3 mg/kg	2005		

(*) At or about the limit of determination.
(fat) (for meat) The MRL/EMRL applies to the fat of meat.

JMPR

Estimate of acceptable daily intake for humans: 0-0.01 mg/kg bw
Estimate of acute reference dose: 0.02 mg/kg bw
(JMPR, 2003)

Other information

The CODEX Pesticide Residues in Food Online database reference above also contains the following information:

Acceptable Daily Intake (ADI)/PTDI	0-0.01 mg/kg body weight - 1986
Residue definition	For compliance with MRLs and for estimation of dietary intake for plant and a commodities: carbosulfan.

4.3 Packaging and labelling

The United Nations Committee of Experts on the Transportation of Dangerous Goods classifies the chemical in:

Hazard Class and Packing Group:	Hazard Class: 6.1 Packing Group III (minor danger) (PPDB, 2014) Packing Group III (minor danger) (PPDB, 2014) IMDG Code: UN No. 2992 For further information on the classification of mixtures, special provisions and packing instructions see United Nations (2015). It is recommended to follow the FAO Guidelines on good labelling practice for pesticides (FAO, 2015). www.fao.org/agriculture/crops/thematic-sitemap/theme/pests/code/list-guide-new/en/
International Maritime Dangerous Goods (IMDG) Code	For carbosulfan (pure substance): UN No. 2992 Carbamate pesticide, liquid, toxic (carbosulfan) Class 6.1 Marine Pollutant / environmentally hazardous substance (aquatic environment), category Acute 1, since 96 h LC50 for fish is < 1 mg/L (United Nations, 2015)
Transport Emergency Card	Not available.

4.4 First aid

NOTE: The following advice is based on information available from the World Health Organisation and the notifying countries and was correct at the time of publication. This advice is provided for information only and is not intended to supersede any national first aid protocols.

In absence of first aid information on carbosulfan from the WHO or the notifying countries, the following has been taken from the 2004 MSDS by FMC for the carbosulfan formulation “Marshal 48% EC Insecticide” (http://www.philagrosa.co.za/products/getfile/10).

This product is moderately toxic if swallowed and slightly toxic if inhaled or absorbed through the skin. It is moderately irritating to the eyes and mildly irritating to the skin. Carbosulfan is a reversible cholinesterase inhibitor. Atropine sulfate is antidotal. It is recommended to support respiration as needed with removal of secretions, maintenance of a patent airway and, if necessary, artificial ventilation. If cyanosis is absent: Adults - start treatment by giving 2 mg atropine intravenously or intramuscularly, if necessary, and repeat with 0.4 - 2.0 mg atropine at 15 minute intervals until atropinization occurs (tachycardia, flushed skin, dry mouth, mydriasis); Children under 12 - initial dose = 0.05 mg/kg body weight and repeat dose = 0.02 - 0.05 mg/kg body weight. Use of oximes such as 2-PAM is controversial. Observe patient to insure that these symptoms do not recur as atropinization wears off. If in eyes, instill one drop of homatropine. Contains aromatic hydrocarbons that may produce a severe pneumonitis if aspirated during vomiting. Consideration should be given to gastric lavage with an endotracheal tube in place. Treatment is otherwise controlled removal of exposure followed by symptomatic and supportive care.

4.5 Waste management

Regulatory actions to ban a chemical should not result in creation of a stockpile requiring waste disposal. For guidance on how to avoid creating stockpiles of obsolete pesticides the following guidelines are available: FAO Guidelines on Prevention of Accumulation of Obsolete Pesticide Stocks (1995), The Pesticide Storage and Stock Control Manual (1996) and Guidelines for the management of small quantities of unwanted and obsolete pesticides (FAO, 1999).

In all cases waste should be disposed in accordance with the provisions of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (1996), any guidelines thereunder, and any other relevant regional agreements.

It should be noted that the disposal/destruction methods recommended in the literature are often not available in, or suitable for, all countries; e.g., high temperature incinerators may not be available. Consideration should be given to the use of alternative destruction technologies. Further information on possible approaches may be found in Technical Guidelines for the Disposal of Bulk Quantities of Obsolete Pesticides in Developing Countries (FAO, 1996).

Annexes

Annex 1 Further information on the substance

Introductory text to Annex I

The information presented in this Annex reflects the conclusions of the notifying parties in two prior informed consent (PIC) regions: WEOG (European Union) and Africa (CILSS countries Burkina Faso, Cabo Verde, Chad, the Gambia, Mauritania, the Niger, Senegal and Togo[4]). A summary of the notification from the EU was published in PIC Circular XXXV of June 2012. A summary of the notifications from CILSS countries was published in PIC Circular XLI of June 2015.

Where possible, information on hazards provided by the notifying parties has been presented together, while the evaluation of the risks, specific to the conditions prevailing in the notifying Parties are presented separately. This information has been taken from the documents referenced in the notifications in support of their final regulatory actions to ban carbosulfan from the European Union (UNEP/FAO/RC/CRC.11/INF/14.En), and CILSS countries (UNEP/FAO/RC/CRC.11/INF/15.En).

[4] These eight parties share a common pesticide registration body, the Sahelian Pesticides Committee set up by the Permanent Interstate Committee for Drought Control in the Sahel (CILSS). As the CILSS member states take together decisions on the registration of pesticides at a regional level, the notifications submitted by the eight African parties refer to the same final regulatory action.

Annex 1 – Further information on Carbosulfan

1. Physico-Chemical properties (most of the information has been sourced from the EU notification UNEP/FAO/RC/CRC.11/7, UNEP/FAO/RC/CRC.11/INF/15.En and EFSA (2006), pp 46-48, except where indicated)

1.1	**Identity**	ISO: Carbosulfan IUPAC: 2,3-dihydro-2,2-dimethylbenzofuran-7-yl(dibutylaminothio)methylcarbamate CA: 2, 3-dihydro-2, 2-dimethyl-7-benzofuranyl[(dibutylamino)thio]methylcarbamate
1.2	**Formula**	$C_{20}H_{32}N_2O_3S$ c1(O2)c(CC2(C)C)cccc1OC(=O)N(C)SN(CCCC)CCCC (SMILES) (UNEP/FAO/RC/CRC.11/INF/15.En, PPDB (2014), p2)
1.3	**Colour and Texture**	Medium yellow viscous liquid.
1.4	**Melting Point**	No clearly defined freezing point (98.5%)
1.5	**Boiling Point**	219.3^{o}C (98.5%)
1.6	**Relative Density**	D_4^{20} = 1.0445 g/cm^3 (98.5%)
1.7	**Vapour pressure**	3.59 x 10^{-5} Pa at 25^{o}C (98.5%)
1.8	**Henry's Law Constant**	124.21 x 10^{-3} Pa.m^3.mol^{-1} (98.5%)
1.9	**Solubility in water**	pH 9, 25^{o}C: 0.11 mg/L (98.5%) no effect of pH (no dissociation in water)
1.10	**Solubility in organic solvents**	Solubility at 23^{o}C: • Hexane – miscible in all proportions • Toluene – miscible in all proportions • Acetone – miscible in all proportions • Acetonitrile – miscible in all proportions Solubility at 20^{o}C (g/L): • Dichloromethane > 250 • Methanol > 250 • Ethyl acetate > 250
1.11	**Partition co-efficient (log K_{OW})**	25^{o}C: 7.42 (98.5%) no effect of pH (no dissociation in water)
1.12	**Dissociation Constant**	No dissociation in water
1.13	**Surface tension**	Not applicable (instability in water)
1.14	**Hydrolytic stability (DT_{50})**	pH 5, 25°C: DT_{50} = 0.2 hr pH 7, 25°C: DT_{50} = 11.4 hr pH 9, 25°C: DT_{50} = 173.3 hr (ca 7 d)

2 Toxicological properties

2.1	**General**	
2.1.1	**Mode of Action**	<u>**European Union**</u> Carbosulfan is a systemic insecticide with contact and stomach action. It inhibits the cholinesterase in the nervous system.
2.1.2	**Symptoms of poisoning**	<u>**European Union**</u> Symptoms of poisoning include excessive sweating, headache, chest tightness, weakness, giddiness, nausea, vomiting, stomach pain, salivation, blurred vision, slurred speech and muscle twitching. Paresthesia and mild skin reactions have also been reported (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2006), p15). <u>**CILSS countries**</u> Poisoning signs vary according to the exposition route: if swallowed, the following can be observed : a lasting cholinesterase inhibition of most tissues, in particular of the central nervous system,

of muscles and blood with an acetylcholine accumulation; early onset of gastrointestinal signs and of muscarinic receptors poisoning : nausea, vomiting, digestive pains and diarrhoea, meiosis, hyper salivation, defecation, urination, bradycardia, high blood pressure, asthmatic dyspnoea; signs of nicotinic receptors poisoning: fasciculation and muscle cramps, involuntary movements, paralysis of respiratory muscles and tachycardia, HBP, confusion, ataxia, convulsive coma, risk of hemodynamic shock;

if inhaled, the same mechanism of action can be observed as if swallowed; less marked gastrointestinal signs; very early respiratory symptoms, asthmatic dyspnoea, bronchial hyper secretion; early signs of muscarinic and nicotinic receptors poisoning; in case of local acute poisoning, skin irritation and good penetration as well as eye irritation with tearing and conjunctivitis. (UNEP/FAO/RC/CRC.11/INF/15.En, SPC (2014), p1)

2.1.3 Absorption, distribution, excretion and metabolism in mammals

<u>European Union</u>

Oral absorption after single low dose exposure is >70 % of the dose based on urinary excretion, exhaled air, tissues, and carcass. Carbosulfan is widely distributed, mainly in excretory organs and carcass. Excretion is rapid and extensive within 24 hours, mainly via urine (63-78%); with no evident accumulation. Metabolism is extensive (>80%): carbosulfan mainly undergoes hydrolysis to form 7-phenol and to form carbofuran products, which can be further metabolised.

Both carbofuran-7-phenol and carbofuran can undergo oxidation to generate 3-hydroxy-carbofuran and 3-keto-carbofuran, which are conjugated and eliminated via urine. (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2009), p11)

2.2 Toxicology studies

2.2.1 Acute toxicity

<u>European Union</u>

Carbosulfan:

- LD_{50} (rat, oral): 138 mg/kg bw
- LD_{50} (rabbit, oral): 42.7 mg/kg bw
- LD_{50} (rat, dermal): 3700 mg/kg bw
- LC_{50} (rat, inhalation): 0.61 mg/L

Metabolite carbofuran:

- LD_{50} (rat, oral): 7 mg/kg bw
- LD_{50} (rat, dermal): 1000-2000 mg/kg bw
- LC_{50} (rat, inhalation): 0.05 mg/L

(UNEP/FAO/RC/CRC.11/7)

Carbosulfan:

- LD_{50} (rat, oral): 101 mg/kg bw (PPDB, 2014)
- LD_{50} (rabbit, dermal): >2000 mg/kg bw

(UNEP/FAO/RC/CRC.11/INF/15.En, SPC (2014), p1)

2.2.2 Short term toxicity

<u>European Union</u>

Carbosulfan:

Target/critical effect: Inhibition of acetyl cholinesterase (rat) and changes in red blood cells parameters and spleen weight (dog)

Lowest relevant oral NOAEL/NOEL: 2 mg/kg bw/day, 90-day rat; 1.6 mg/kg bw/day, 6-month dog

Lowest relevant dermal NOAEL/NOEL: 5 mg/kg bw/day, 21-day rabbit

Lowest relevant inhalation NOAEL/NOEL: 0. 15 mg/m^3, 28-day rat

(UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2009) p56)

		Metabolite carbofuran: Target/critical effect: testicular degeneration, clinical signs of neurotoxicity related to acetylcholinesterase inhibition (rat and dogs) Lowest relevant oral NOAEL/NOEL: 0.1 mg/kg bw/day (1-year dog and 60-day rat, published study) Lowest relevant dermal NOAEL/NOEL: 25 mg/kg bw/day (21-day rabbit) Lowest relevant inhalation NOAEL/NOEL: No study available (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2006), p55)
2.2.3	**Genotoxicity (including mutagenicity)**	**<u>European Union</u>** Carbosulfan: Not genotoxic *in vitro* and *in vivo*. (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2006), p53). Metabolite carbofuran: *In vitro*: Positive in bacterial tests *In vivo*: Negative (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2006), p55)
2.2.4	**Long term toxicity and carcinogenicity**	**<u>European Union</u>** Carbosulfan: Target/critical effect: Acetylcholinesterase inhibition, focal iris atrophy and degenerative retinopathy (rat). Lowest relevant NOAEL/NOEL: 1 mg/kg bw/day (rat, diet, 2-year); 2.5 mg/kg bw/day (mouse, 2-year) (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2009), p12) Carcinogenicity: No carcinogenic potential. (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2006), p54) Metabolite carbofuran: Target/critical effect: Body weight, acetylcholinesterase inhibition (rat) NOAEL: 0.462 mg/kg bw/day (rat, diet, 104-weeks) No carcinogenic potential. (UNEP/FAO/RC/CRC.11/7)
2.2.5	**Effects on reproduction**	**<u>European Union</u>** Carbosulfan: Reproduction target/critical effect: Reduced number of born pups, litter size, put weight at parental toxic doses (rat). Lowest relevant reproductive NOAEL/NOEL: Maternal and reproductive: 1.2 mg/kg bw/day. Developmental target/critical effect: Incomplete ossification at maternal toxic dose (rat). Lowest relevant developmental NOAEL/NOEL: Maternal and developmental, 2 mg/kg bw/day (rat) (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2009), p12) Metabolite carbofuran: Reproduction target/critical effect: Reduced litter parameters in rat multigeneration study, testicular and sperm toxicity (published study, rat). Lowest relevant reproductive NOAEL/NOEL: Parental and reproduction: 1.2 mg/kg bw/day (rat) Developmental target/critical effect: Fetotoxicity and developmental neurotoxicity at maternal toxic doses (rat). Lowest relevant developmental NOAEL/NOEL: • Rat: Developmental: 1 mg/kg bw/day

- Rat: Maternal: 0.1 mg/kg bw/day
- Rabbit: Developmental and maternal: 0.5 mg/kg bw/day.

(UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2006), p55)

2.2.6 Neurotoxicity/ delayed neurotoxicity, Special studies where available

<u>European Union</u>

Carbosulfan:

No delayed neuropathy in hens; LD_{50}: 376 mg/kg bw (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2009), p57)

Carbosulfan displayed no potential for development of clinical signs or morphologic changes associated with organophosphorus induced delayed neurotoxicity. In a further acute neurotoxicity study, the NOAEL was 0.5 mg/kg bw, based on decreased brain and erythrocyte acetylcholinesterase activity observed at 5 mg/kg bw. In the subchronic neurotoxicity study, clinical signs of neurotoxicity, effects on body weight and reduced food consumption were noted at 64.8 mg/kg bw/day (1000 ppm) and the NOAEL was 1.2 mg/kg bw/day (20 ppm). (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2009), p13)

Metabolite carbofuran:

No delayed neurotoxicity in hens; NOAEL neurotoxicity: 0.5 mg/kg bw

Subchronic neurotoxicity test: 3.2 mg/kg bw/day, 13-week rat.

(UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2006), pp55-56)

2.2.7 Summary of mammalian toxicity and overall evaluation

European Union

Oral absorption after single low dose exposure is >70 % of the dose based on urinary excretion, exhaled air, tissues, and carcass. Carbosulfan is widely distributed, mainly in excretory organs and carcass. Excretion is rapid and extensive within 24 hours, mainly via urine (63-78%); with no evident accumulation. Metabolism is extensive (>80%): carbosulfan mainly undergoes hydrolysis to form 7-phenol and to form carbofuran products, which can be further metabolised. The information presented on carbofuran and other metabolites was also used in the assessment of the active substance, carbosulfan. The presence of the impurity, N-nitrosobutylamine was also considered.
(UNEP/FAO/RC/CRC.11/7)

3 Human exposure/Risk evaluation

3.1 Food

<u>European Union</u>

Acceptable Daily Intake (ADI): 0.005 mg/kg bw/day (based on rat neurotoxicity study with 100 Safety Factor)
(UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2009), p14)

Consumer risk assessment:

In the additional report (Belgium 2009a) the RMS has provided a comprehensive dietary exposure and risk assessment for consumers using both the EFSA PRIMo and the UK model.

The estimated dietary intake of carbosulfan was in those calculations significantly below (<5%) the allocated carbosulfan ADI of 0.005 mg/kg bw/day for all considered consumer groups.

The sum of intakes of carbofuran and 3-hydroxy-carbofuran from the primary crop, rotational crops and food of animal origin was considered and compared to the toxicological reference values for carbofuran (ADI and ARfD, both 0.00015 mg/kg bw /day). This approach is deemed to be appropriate as the metabolite 3-hydroxy-carbofuran is assumed to be of comparable toxicity as carbofuran based on acute toxicity studies. It is noted that the assessment does not yet consider the revised residue definition for risk assessment (including free and conjugated residues of 3-keto carbofuran), and the establishment of appropriate conversion factors to take into account for residues of 3-keto carbofuran is still pending.

		An exceedance of the ADI was noted for UK toddlers in the EFSA PRIMo 173% ADI and the ADI was almost reached for toddlers in the UK model (98% ADI). The acute consumer risk assessment indicates the ARfD is significantly exceeded for a number of crops consumed by children and by adults/the general population. A great exceedance of the ARfD was observed for leafy (up to 1800% ARfD) and root/tuber crops (up to 615% ARfD). These results highlight the importance of residue data on succeeding crops to enable further refinement of the dietary risk assessment for consumers. (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2009) p23) **JMPR** Estimate of acceptable daily intake for humans: 0-0.01 mg/kg bw Estimate of acute reference dose: 0.02 mg/kg bw (JMPR, 2003)
3.2	**Air**	**European Union** It is not expected that either carbosulfan or its transformation product carbofuran (from data in carbofuran dossier) may contaminate the air compartment or be prone to long range transport through air. (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2009), p4)
3.3	**Water**	**European Union** The potential for groundwater exposure from the representative uses by the parent carbosulfan or the metabolite dibutylamine above the parametric drinking water limit of 0.1 µg/L, was concluded to be low in geoclimatic situations that are represented by all 9 FOCUS groundwater scenarios. However it is noted that some parameters of the metabolite dibutylamine used in the simulations are uncertain. The main metabolite carbofuran was calculated to be present in leachate leaving the top 1m soil layer at 80th percentile annual average concentrations >0.1µg/L in case of 8 out of the 9 modelled FOCUS scenarios with the range of 0.22-4.09 µg/L using the PEARL model, and 7 out of the 9 modelled FOCUS scenarios with the range of 0.32-0.73 µg/L using the PELMO model, when annual applications were simulated. Only the Porto (PEARL) or Porto and Thiva (PELMO) FOCUS scenarios resulted in a PECgw value <0.1µg/L (0.023 µg/L, 0.009 µg/L and 0.004 µg/L, respectively). When triennial applications were simulated by FOCUS PEARL, 7 out of the 9 modelled FOCUS scenarios exceeded the 0.1µg/L parametric drinking water limit with the range of 0.24-1.11 µg/L, and again Porto and Thiva FOCUS scenarios resulted in a PECgw value <0.1µg/L (0.012 µg/L and 0.069 µg/L, respectively). When FOCUS PELMO was used for the simulation of triennial applications, 5 out of the 9 modelled FOCUS scenarios exceeded the 0.1µg/L parametric drinking water limit with the range of 0.15-0.30 µg/L. The Kremsmünster, Porto, Sevilla and Thiva FOCUS scenarios resulted PECgw <0.1µg/L (0.002 – 0.099 µg/L). The PECgw for the metabolites 3-keto-carbofuran and 3-hydroxy-carbofuran exceeded the 0.1µg/L parametric drinking water limit only in a few cases of FOCUS simulations when annual applications were simulated. When triennial applications were simulated, 3-keto-carbofuran exceeded this trigger only in one case (FOCUS PEARL, Piacenza scenario) of the simulations. However, it is noted that the simulations for the metabolites were regarded as worst case, as 100 % formation was assumed (which would be expected to be lower in reality). On the other hand it is also noted that another parameter (DT50 of the parent molecule) used in these simulations is regarded as favourable for all the metabolites. In summary, the potential for groundwater exposure from the representative uses by carbofuran, as a metabolite of the parent carbosulfan, above the parametric drinking water limit of 0.1 µg/L, was concluded to be very high in geo-climatic situations that are represented by 8 out of the

		9 FOCUS groundwater scenarios. Even at the drinking water limit of 0.1 μg/L that is applied to groundwater, consumer exposure would be greater than 10% of the toxicological reference values for vulnerable consumer groups (toddlers and infants). Therefore a drinking water limit <0.1 μg/L is needed for the carbamate structured metabolites according to uniform principles. However, a method with a validated LOQ < 0.1 μg/L for each analyte is not available. (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2009), p4)
3.4	**Occupational exposure**	**<u>European Union</u>** Worker exposure: As Marshal 10G is applied to the soil at the time of planting/transplanting and incorporated, workers entering treated areas are not likely to be exposed to dislodgeable foliar residues of carbosulfan. (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA(2009), p16)
3.5	**Medical data contributing to regulatory decision**	
3.6	**Public exposure**	**<u>European Union</u>** Bystander exposure: Marshal 10G: No established models are available to estimate the level of bystander exposure likely to arise during granule application. It can be assumed that bystanders may be present during the field use of Marshal 10G. In the additional report, the rapporteur Member State expressed the opinion that the use of granular applicators distributing granules by drilling eliminates bystander exposure. (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2009) , p16)
3.7	**Summary- overall risk evaluation**	**<u>European Union</u>** It was concluded that carbosulfan was not demonstrated to fulfil the safety requirements laid down in Article 5 (1) (a) and (b) of Directive 91/414/EEC. Certain metabolites with a hazardous profile appear with the use of carbosulfan. Some of these metabolites could be genotoxic. Due to uncertainties on this issue, and based on the current knowledge and the available data, risks regarding the exposure of consumer could not be excluded. In addition, impurities, of which at least one is carcinogenic (N-nitrosodibutylamine) were found in the substance as sold in the market (technical substance) at levels raising concerns. however a new specification submitted during a resubmission indicated this substance no longer exceeded the limit of 1mg/kg and concerns over this impurity could be considered as addressed (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2009), p13). The further review in 2009 noted possible exceedance of the Acceptable Daily Intake by toddlers and acute risk to children and adults from consumption of a number of crops. (UNEP/FAO/RC/CRC.11/7) **<u>CILSS countries</u>** The Sahelian Pesticides Committee stopped the registration of carbosulfan based pesticides in 2006 taking into account the following reasons: (a) The fragile ecology of CILSS countries already characterised by an imbalance of ecosystems and the disappearance of organisms useful to the environment; (b) Non-compliance with recommended measures for a safe use of carbosulfan by users in the context of CILSS countries;

(c) The low utilisation rate of protective equipment by growers;

(d) The existence of alternatives to the use of carbosulfan.

In April 2015, on recommendation of the Sahelian Pesticides Committee, carbosulfan was banned by decision of the CILSS Coordinating Minister (Minister of Agriculture and Environment) due to unacceptable risk to the human health (difficulty to handle carbosulfan by users from Sahel Countries without risks) and non-target organisms in the environment. The ban of carbosulfan in several other countries such as the EU is also mentioned (UNEP/FAO/RC/CRC.11/INF/15.En, SPC (2014), pp3-5).

In the notifications, the following hazards to human health are reported: carbosulfan belongs to WHO Class II (moderately hazardous) (Footprint, 2011; WHO, 2008); it is a cholinesterase inhibitor (FAO, 2003). Furthermore, the notification states that during a pilot study carried out in Burkina Faso in June 2010, through both retrospective and prospective surveys, one carbosulfan based formulation was involved in a poisoning case: PROCOT 40 WS, a tertiary formulation containing carbosulfan (250 g/kg), carbendazim (100 g/kg) and metalaxyl-M (50 g/kg) (UNEP/FAO/RC/CRC.11/7), (UNEP/FAO/RC/CRC.11/INF/15.En, SPC (2014), p3).

4 Environmental fate and effects

4.1 Fate

4.1.1 Soil

European Union

Route of degradation (aerobic) in soil:
Mineralization after 100 days: 0.55-7.3% after 28-120 d, [14C-phenyl ring]-label (n = 6): 46.5-46.7% after 28 d, [14C-dibutylamine]-label (n = 2)
Non-extractable residues after 100 days: 34.4-90.3% after 28-120 d, [14C-phenyl ring]-label, (n= 6): 29.9-35.1 % after 28 d, [14C-dibutylamine]-label (n = 2)
Relevant metabolites

Carbofuran : 34.6 - 69.3% at 7-14 days (n = 6)
3-keto-carbofuran: 6.6% AR at 28 d (end of the study)
Dibutylamine: 15.4 - 21.5% at 0-3 days (n = 2)

Route of degradation in soil - Supplemental studies:
Soil photolysis: No data available, studies performed with metabolite carbofuran show that this metabolite is stable to photolysis in soil.
Rate of degradation in soil, Laboratory studies:
DT_{50} carbosulfan: 0.53-11.4 d (20°C, pF2), geometric mean: 4.81 d
DT_{50} metabolite carbofuran (study performed with carbosulfan): 6.92-22.5 d (20°C, pF2),
DT_{50} metabolite carbofuran (study performed with carbofuran): 7.71-387 d (20°C, pF2),
DT_{50} metabolite carbofuran (study performed with benfuracarb): 5.7-20.4 d (20°C, pF2),
Overall median DT_{50} carbofuran: 14 d
DT_{50}lab carbosulfan (10°C, aerobic): 21.7 d (n = 1, X^2 = 10.86)
Field studies (Field studies where carbosulfan was applied as parent):
DT_{50}f carbosulfan: Netherlands, Spain, Italy, bare soil: 0.35-9.8 .d (n = 5, r^2 = 0.88-0.997) 1st order
DT_{50}f carbofuran: Netherlands, Spain, Italy, bare soil, 1.3-27 d (n = 5, r^2 = 0.88-0.997) 1st order
DT_{50}f dibutylamine: Netherlands, Spain, Italy, bare soil, 2.2-54 d
Overall geometric mean: 20.75 d (no normalization possible with the available data in the summary of the studies).
DT_{50}f carbosulfan: Netherlands, Spain, Italy, bare soil: 1.2-33 d (n = 5, r^2 = 0.88-0.997) 1st order
DT_{50}f carbofuran: Netherlands, Spain, Italy, bare soil, 4.4-91 d (n = 5, r^2 = 0.880-0.997) 1st order

DT_{50}f dibutylamine: Netherlands, Spain, Italy, bare soil, 7.4-181 d (n = 5, r^2 = 0.820-0.997) 1st order

Mobility in soil
Soil adsorption/desorption
Carbosulfan: K_{FOC} = 12895-33314 (mean 20081, n = 4) from EU supporting information (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2009), p28); also reported as 2113 in CILSS supporting information (UNEP/FAO/RC/CRC.11/INF/15.En, PPDB (2014), p6)
Metabolite carbofuran: K_{FOC} = 17-28 (mean 22, n = 4)
Metabolite 3-hydroxy-carbofuran: K_{OC} = 43-62 (mean 55, n = 3)
Metabolite 3-keto-carbofuran: K_{FOC} = 440-504 (n = 2)
Metabolite carbofuran-phenol: K_{FOC} = 444-1810 (mean 103), n = 3)
Metabolite dibutylamine: K_{FOC} = 250-684 (mean 409, n = 3)

Lysimeter/ field leaching studies
Location: Germany, Lower Saxony, Borstel, loamy sand
Study type: 2 lysimeters over 2 years
Number of applications: 1 application
Application rate: 1.05 kg/ha/year on bare soil
Average annual rainfall: 800 mm
Average annual leachate volume: 493 mm
Annual average concentrations: 0.82-0.85 µg equivalent a.s./L
(no information on
the leachate concentrations of carbosulfan, carbofuran and possible metabolites)
(UNEP/FAO/RC/CRC.11/7)

4.1.2 Water

European Union
Route and rate of degradation in water:
Hydrolysis of active substance and relevant metabolites (DT_{50}):
pH 5, 25°C: DT_{50} = 0.2 h (1st order)
Major hydrolysis products: Carbofuran and dibutylamine; carbofuran decomposes
to 7-phenol under basic conditions
pH 7, 20°C: DT_{50} = 11.4 h (1st order)
distilled water (pH 7.3): DT_{50} = 18.2 h (1st order)
pH 9, 20°C: DT_{50} = 173.3 h (ca 7 d) (1st order)
Not readily biodegradable: 28% biodegradation after 28 days
Degradation in water/sediment
DT_{50} water: 0.54 - 3.2 days
DT_{50} whole system: 3.6 - 5.6 days

Mineralization: 20.00 - 30.38% AR (at 102 d, study end, n = 3)
Non-extractable residues: 30.53 - 42.99% AR (at 102 d, study end, n = 3)

Distribution in water/sediment systems (active substance): Maximum of 17.61 - 32.03% AR in sediment after 2-7 days.

Distribution in water/sediment systems (metabolites):
Water
Carbofuran: max. of 24.36 - 33.24% (7-14 days, n = 3);
DT_{50} (whole system) = 14 - 51 d (n = 2)
7-phenol: max of 1.4 - 23% (1-100 days, n = 3)

Sediment:
Carbofuran: max. of 11.76 - 20.09% (0.25-14 days, n = 3)
Unknown 3: max. of 11.57 - 16.53% (0.25-2 days, n = 2)
(UNEP/FAO/RC/CRC.11/7)

CILSS countries
Carbosulfan is not mobile (Koc = 9489 mL/g) (Footprint, 2011). It therefore does not present a risk of surface water pollution by runoff. It is not persistent in the soil (DT50 = 21 days). Carbosulfan presents a

		low ground water pollution risk considering GUS which is of 0.89 (Footprint, 2014). Aqueous photolysis DT_{50} (days) at pH 7: 0.6 Aqueous hydrolysis DT50 (days) at 20^{o}C and pH 7: 0.5 (Note pH sensitive: DT_{50} 0.2 hours at pH 5, 7.2 days at pH 9, 20^{o}C) Water-sediment DT_{50} (days): 4.8 Water phase only DT_{50} (days): 1.6 (UNEP/FAO/RC/CRC.11/INF/15.En, SPC (2014), p2)
4.1.3	**Air**	**<u>European Union</u>** Photochemical oxidative degradation in air DT so of 2.0 hours derived by the Atkinson method of calculation. (UNEP/FAO/RC/CRC.11/7) Carbosulfan is not a volatile compound. It is not expected that carbosulfan may contaminate the air compartment or be prone to long range transport through air. Carbosulfan transform in the active substance carbofuran. No data on the fate in air of carbofuran is available in the carbosulfan dossier. Data in the carbofuran dossier shows that contamination of the air compartment and long range transport through air is not expected for carbofuran. (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2006), p28)
4.1.4	**Bioconcentration**	**<u>European Union</u>** Bioconcentration factor (BCF): 990 (whole fish), 730 (fillet), 1100 (viscera) (UNEP/FAO/RC/CRC.11/INF-14, EFSA (2009) p35) **<u>CILSS countries</u>** Bioaccumulation: 2205 (UNEP/FAO/RC/CRC.11/INF/15.En, INERIS (2015), p2)
4.1.5	**Persistence**	**<u>European Union</u>** Rate of degradation of carbosulfan in soil under dark aerobic conditions was calculated in the same studies provided to investigate the route of degradation. However, data from not acceptable studies are taken into account the table B.8.1.2.1-1 of the Draft Assessment Report were the half-lives are summarized and the mean calculated. It is emphasized that only studies by Baumann (2002) and Markle (1981a, 1981b) were considered of sufficient quality to be used in the risk assessment. Evaluation meeting agreed that a re-evaluation of the degradation kinetic in degradation studies, including assessment of the goodness of fit, needs to be performed by the applicant. Reassessment was provided to the rapporteur Member State in June 2005 but has still not been assessed and peer reviewed. Therefore, it has not been possible to agree during the Peer Review on the laboratory degradation end points for carbosulfan. In a separated non-radio labelled study, rate of degradation of carbosulfan was also measured under dark aerobic conditions in one soil (pH 7.1, OC 3.89 %, clay 16.5 %) at 10ºC and 40 % MWHC. Under these conditions a half-life of 25.4 d was obtained (as reported in table B.8.1.2.1-1). Summaries of some field dissipation studies performed with carbosulfan in EU are available. Half-life of carbosulfan in these trials ranges between 0.35 to 31.3 d. Half-life of metabolite carbofuran in the these trials ranges between 1.3 to 71.9 d. EFSA notes that in the context of the carbofuran discussion, the meeting of MS experts was not able to determine the reliability of these studies. A position paper from the applicants is available (June 2005) but has still not been assessed and peer reviewed. Also some summaries of field studies performed in USA are available in the dossier. The meeting of MS experts agreed that to assess these studies with respect to EU conditions more background information would be needed.

PEC in soil were calculated in the Draft Assessment Report for carbosulfan and carbofuran based on the field worst case half-lives (DT_{50} carbosulfan = 35 d, DT_{50} carbofuran = 71.9 d) and the representative uses in maize and sugar beet (Marshal 10G) and citrus and cotton (Marshal 25 CS).

No degradation parameters are available for soil metabolite dibutylamine. Evaluation meeting agreed that half-life of dibutylamine in soil and PEC soil for this metabolite need to be determined. (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2006), p25)

4.2	**Effects on non-target organisms**	
4.2.1	**Terrestrial vertebrates**	<u>**European Union**</u> Acute toxicity to mammals: LD_{50} = 42.7 mg/kg bw/d (rabbit) Reproductive toxicity to mammals: NOAEL = 20 ppm (1.2 mg/kg bw/d); Reduced number born pups at parental toxic doses (rat) Acute toxicity to birds: LD_{50} = 10 mg a.s/kg bw (mallard duck) Acute toxicity to birds (MARSHAL 25CS): LD_{50} = 8-16 mg/kg bw Dietary toxicity to birds LC_{50} = 3.99 mg a.s/kg bw/day (mallard duck) Reproductive toxicity to birds: NOEL = 30 mg a.s/kg feed or 2.5 mg a.s/kg bw/day (mallard duck) (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2006), p76)
4.2.2	**Aquatic species**	<u>**European Union**</u> Laboratory tests: Carbosulfan *Lepomis macrochirus* 96 h Mortality, LC_{50} : 0.015 mg/L *Oncorhynchus mykiss* 14 d Prolonged tox, growth NOEC: 0.004 mg/L *Daphnia magna* 48 h Mortality, EC_{50}: 0.0015 mg/L *Daphnia magna* 21 d Reproduction, NOEC: 0.0032 mg/L *Pseudokirchneriella subcapitata* 96 h EC_{50}: > 20 mg/L Laboratory tests: Carbofuran *Gammarus fasciatus* 96 h LC_{50} of 0.0028 mg/L *Oncorhynchus mykiss* 96 h EC_{50}: 0.3625 mg/L *Cyprinodon variegatus* 35 d early life stage, NOEL: 0.006 mg/L *Daphnia magna* 48 h Mortality, EC_{50} : 0.0386 mg/L *Ceriodaphnia dubia* 7 d Reproduction, NOEC: 0.00016 mg/L *Chironomus riparius* 28 d NOEC: 0.0032 mg/L (0.0022 mg/kg) Laboratory tests: 7-phenol *Oncorhynchus mykiss* 96 h Mortality, LC_{50}: 32.3 mg/L *Daphnia magna* 48 h Mortality, EC_{50}: 30 mg/L *Pseudokirchneriella subcapitata* 72 h E_bC_{50}: 47 mg/L, E_rC_{50} : 83 mg/L Laboratory tests: Dibutylamine *Oncorhynchus mykiss* 96 h Mortality, LC_{50}: 18 mg/L *Daphnia magna* 48 h Mortality, EC_{5-}: 4.2 mg/L *Pseudokirchneriella subcapitata* 72 h E_bC_{50}: 24 mg/L, E_rC_{50}: 31 mg/L Laboratory tests: MARSHAL 25CS *Daphnia magna* 48 h Mortality, EC_{50}: 0.0043 mg formulation/L (0.00104 mg a.s./L) *Pseudokirchneriella subcapitata* 72 h E_bC_{50}: 429 mg/L, E_rC_{50}: 805 mg/L Marshal 10G *Daphnia magna* 48 h Mortality, EC_{50}: 0.01 mg formulation/L (0.00105 mg a.s./L) Microcosm or mesocosm tests Outdoor mesocosm containing aquatic invertebrates, algae and macrophytes, 1 application, the test item is MARSHAL 25CS (capsule suspension containing 250 g/L carbosulfan). A NOAEC of 0.4 µg

carbosulfan/L was derived; with an assessment factor of 4 this leads to an EAC of 0.1 µg carbosulfan/L.
(UNEP/FAO/RC/CRC.11/INF/14.En, EFSA(2009), pp89-91)

4.2.3	**Honeybees and other arthropods**	**<u>European Union</u>** Honeybees: Acute oral toxicity LD_{50} (48 h, carbosulfan): 0.18 µg a.s./bee Acute contact toxicity LD_{50} (48 h, carbosulfan): 1.035 µg a.s./bee Acute oral toxicity LD_{50} (48 h, carbofuran): 0.05 µg a.s./bee Acute contact toxicity LD_{50} (48 h, carbofuran): 0.038 µg a.s./bee (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2009), p101) No exposure of bees is expected from the use in sugar beet since sugar beets are wind pollinated and the production crop is harvested before flowering. Therefore the risk to bees from the representative use in sugar beets is considered to be low. (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2009), p35) Arthropods: Laboratory tests *Typhlodromus pyri* protonymphs - carbosulfan 0.12 kg a.s./ha, 1 day: mortality 96% *Aphidius rhopalosiphi* Adult wasps - carbosulfan 0.12 kg a.s./ha, 2 days: mortality 100% (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2009), p102) Arthropods: Extended laboratory tests *Poecilus cupreus* adult beetles - carbosulfan 0.12 kg a.s./ha, 14 days: mortality 76.7%, food consumption no adverse effect (+ 89%) *Pardosa* sp. 3 weeks old - carbosulfan 0.12 kg a.s./ha, 14 days: mortality 100% /(1d) *Poecilus cupreus* adults - 1.51 mg a.s./kg dw soil, 14 days: mortality 3.45% *Aleochara bilineata* adults - 0.30-1.5 mg a.s./kg dw soil, 64 d: reproduction EC_{50} = 1.68 mg a.s./kg dw soil (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2009), pp102-103) Arthropods: Field or Semi-field test *Pardosa* sp. Adult spiders (small potato field enclosure) - MARSHAL 25EC 0.375 kg a.s./ha: mortality 100% after 24 h, 46% after 5 days (for the newly introduced spiders) (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2009), pp103-104) No statistical significant adverse effects on soil dwelling arthropods were observed at the application rate of 750 g a.s./ha. Overall it was concluded that there was a low risk to non-target arthropods for the representative use. (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2009), p35)
4.2.4	**Earthworms**	**<u>European Union</u>** Acute toxicity: Carbosulfan, not available Reproductive toxicity: Carbosulfan, not available (UNEP/FAO/CRC.11/7) **<u>CILSS countries</u>** Acute 14 day LC_{50}: 4.8 mg/kg *Lumbricus terrestris* (UNEP/FAO/RC/CRC.11/INF/15.En, PPDB (2014), p8)
4.2.5	**Soil microorganisms**	**<u>European Union</u>** Nitrogen mineralization (carbosulfan): +2.16 % effect at day 28 at 10.0 mg Marshal 10G/kg d.w. soil (7.5 kg Marshal 10G/ha) +11.5 % effect at day 28 at 50.0 mg Marshal 10G/kg d.w. soil (37.5 kg Marshal 10G/ha) Carbon mineralization (carbosulfan)

-4.13 % effect at day 28 at 10.0 mg Marshal10G/kg d.w. soil (7.5 kg Marshal10G/ha)
-7.71 % effect at day 28 at 50.0 mg Marshal 10G/kg d.w. soil (37.5 kg Marshal10G/ha)
(UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2009), p106)

Nitrogen mineralization: (carbofuran) No effect after 28 days at the application
rates of 16 and 80 mg Furadan 5 G/kg soil (0.8 and 4 mg carbofuran/kg soil)

Carbon mineralization: (carbofuran) No effect after 28 days at the application rates
of 16 and 80 mg Furadan 5 G/kg soil (0.8 and 4 mg carbofuran/kg soil) (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2006), p82)

The risk to soil micro-organisms was considered as low since no significant effects on nitrification and soil respiration were observed in a study with the formulation Marshal 10G at concentrations 5 times greater than the initial PEC_{soil} (application rates up to 50 mg product/kg soil which corresponds to about 5 mg carbosulfan/kg soil). (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2009), p36)

4.2.6 Terrestrial plants

European Union

No effects on seedling emergence were observed in a study with 2 monocotyledonous and 4 dicotyledonous plant species. Reduced shoot weight was observed in the study at high application rates (1.5 kg a.s./ha). The risk to non-target plants in the off-field area is considered as negligible due to the application method (in-furrow application of granules) (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2009), p36).

5 Environmental Exposure/Risk Evaluation

5.1 Terrestrial vertebrates

European Union

Acute, short-term dietary and reproductive toxicity studies are available to assess the risk from carbosulfan. An acute bird study with the formulation MARCHAL 25 CS is also available that indicates that this formulation might be somewhat more toxic than what is expected from the content of the active substance. No study with the granular formulation was available in the Draft Assessment Report.
The proposed representative uses of carbosulfan are as insecticide with foliar application of the product MARCHAL 25 CS in cotton and citrus, and application of the granular formulation MARCHAL 10 G in maize and sugar beet.
The first tier risk from the use of MARSHAL 25 CS to generic species, representing insectivorous birds in citrus and cotton, medium herbivorous birds in cotton and small herbivorous mammals in citrus, was assessed according to the SANCO/ 4145/2000. All TER values are below the relevant Annex VI trigger indicating a potential risk.
For the granule formulation the acute LD_{50}, the acute NOEL, the dietary LC_{50} and the $NOEL_{reproduction}$ were recalculated in number of granules for different sizes of birds and mammals. The numbers of granules that have to be ingested by a bird to reach the LD_{50} or LC_{50} are low, especially for small birds (11 and 4 respectively). Wildlife observations in one field treated with MARSHAL 10 G are available. However the information was considered of limited value by the rapporteur Member State. The number of granules that have to be ingested by a mammal to reach the LD_{50} is 30.5. Granules are not attractive to mammals and the acute risk can therefore be considered as low. To reach the NOAEL for mammals 1, 2 and 9 granules have to be ingested by a 10 g, 25 g and 100 g mammal respectively. The experts' meeting agreed that the risk has to be further addressed. Also the risk from ingestion of treated seedlings needs to be further addressed for both birds and mammals. The applicant proposed to use a residue value

of 0.1 mg/kg based on a metabolism study in maize. However actual carbofuran concentrations of 2.79 mg/kg measured in maize after 31 days indicate that the concentration in seedlings could be higher. No assessment of the risk from secondary poisoning or from exposure to contaminated drinking water was presented in the Draft Assessment Report. The risk to birds and mammals from consumption of contaminated earthworms was assessed by the rapporteur Member State and presented in an addendum of May 2006 but has not been peer reviewed.
Additional data and refined assessments are needed in order to conclude on the risk to birds and mammals from both evaluated representative uses. The reader is referred to the "List of studies to be generated, still ongoing or available but not peer reviewed" for details. (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2006), p29)

CILSS Countries (hazard data provided):
Carbosulfan is highly toxic to birds (LD_{50} *Anas platyrhynchos* = 10 mg/kg)
(UNEP/FAO/RC/CRC.11/INF/15.En, SPC (2014), p3)

Carbosulfan is moderately acutely toxic to mammals. Oral LD_{50} is 101 mg / kg in rats. LD_{50} for Carbosulfan was > 2000 mg / kg body weight in rabbits treated by dermal route and LC_{50} was 0,61 mg / l in rats treated by inhalation
(UNEP/FAO/RC/CRC.11/INF/15.En, SPC (2014), p1).

5.2 Aquatic species

European Union
Based on the available acute toxicity data, carbosulfan is classified as very toxic to aquatic organisms, with an EC_{50} of 0.0015 mg/L for *Daphnia magna* the most sensitive species tested. Also the metabolite carbofuran is very toxic to aquatic organisms with the lowest acute toxicity value obtained for *Gammarus fasciatus* with a LC_{50} of 0.0028 mg/L.
The first tier TER values for carbosulfan were calculated based on PEC_{sw} from spray drift for the use of MARCHAL 25 CS in cotton and citrus. TER values for carbofuran were calculated considering drainage as route of entry. In the case of the granular formulation MARCHAL 10 G for use in maize and sugar beet, only carbofuran is expected to reach surface water. Based on available PEC_{sw} values from spray drift, risk mitigation measures comparable to more than 50 m buffer zones would be needed to meet the Annex VI acute trigger for invertebrates in both cotton and citrus and for fish in citrus. Based on available PEC_{sw} for the use in maize and sugar beet a first tier long-term risk was identified for invertebrates from exposure to carbofuran. It was however agreed in the experts' meeting that for MARCHAL 10 G a revised assessment based on PEC_{sw} from FOCUS modelling should be provided. It should be noted that also for the use of MARCHAL 25 CS drainage and runoff events are likely to contribute to contamination of surface water with carbofuran. The EFSA proposes that the assessments for all uses are reconsidered using PEC_{sw} from FOCUS modelling (see 4.2.1)
An available mesocosm study was discussed by the Member State experts. A revised assessment of this study was required. The applicant should provide raw data and the representativeness of the study especially as regarding species diversity should be considered. In particular the effects on chironomids need to be addressed. Furthermore, it was required that multivariate statistical analysis should be presented and taken into consideration when proposing any uncertainty factor. Additionally it was concluded that the study covers only one application and that it needs to be re-evaluated taking into account the PPR Panel opinion on dimoxystrobin.
Carbosulfan was rapidly degraded to carbofuran and 7-phenol in the water/sediment study. The metabolite 7-phenol is less toxic to *Daphnia* by a factor of 2000. The mesocosm study is considered to cover the

risk to aquatic invertebrates, algae and macrophytes from all metabolites. However the study needs to be reassessed before any conclusion can be drawn.
Carbosulfan showed significant bioaccumulation with a maximum BCF value of 990 in whole fish. At the end of the 30 day depuration period 40%, 28% and 28% of the accumulated residues were still detected in fillet, viscera and whole fish respectively.
Data on acute toxicity of the metabolites carbofuran-7 phenol and dibutylamine for species representing fish, aquatic invertebrates and algae show that these metabolites are more than one order of magnitude less toxic than carbosulfan and carbofuran.
(UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2006), pp30-31)

CILSS Countries (hazard data provided):
Carbosulfan is highly toxic to fish (LC_{50} 96h *Lepomis macrochirus* = 0.015 mg/L), and aquatic invertebrates (EC_{50} 48h *Daphnia magna* = 0.0032 mg/L)
(UNEP/FAO/RC/CRC.11/INF/15.En, SPC (2014), p3)

5.3 Honey bees

European Union
Exposure of bees from the use in citrus and cotton is possible by overspraying of bees foraging on flowering crop or weeds, by ingestion of contaminated nectar, pollen or honey dew and by contact with residues on plants. Carbosulfan and its metabolite carbofuran are systemic compounds and could potentially be found in the pollen following application of the granular formulation. The oral and contact toxicity to bees was tested with carbosulfan. Results from an acute contact toxicity test with carbofuran are also available. However, data on acute oral toxicity of carbofuran is missing. Oral and contact HQ values for carbosulfan are above the Annex VI trigger of 50 indicating a high risk. For the representative uses in citrus and cotton the risk needs to be further addressed by semi-field or field tests. Since sugar beet crop is not flowering and therefore not attractive to bees, the risk from the use of the granular formulation in sugar beet is considered low. For the use of the granular formulation in maize the rapporteur Member State conducted an assessment based on the potential exposure to carbosulfan and carbofuran in pollen. The concentration of both substances in pollen was assumed to be 0.05 mg/kg based on concentrations <0.05 mg/kg in various plant matrices and the toxicity to larvae was assumed to be similar to adults. However, since data on the oral toxicity of carbofuran is missing the assessment was not finalised. A new acute oral toxicity study with carbofuran was submitted by the applicant in July 2005 together with a revised risk assessment. The study and the risk assessment have however not been evaluated by the rapporteur Member State.
(UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2006), p31)

Carbosulfan and carbofuran are very toxic to bees with acute oral and contact LD50 ranging from 0.038 μg carbofuran/bee to 1.035 μg carbosulfan/bee. No exposure of bees is expected from the use in sugar beet since sugar beets are wind pollinated and the production crop is harvested before flowering. Therefore the risk to bees from the representative use in sugar beets is considered to be low.

Crop and application rate : sugar beet, 1 x 0.750 kg a.s./ha, in-furrow

The calculated Hazard Quotients are not relevant for granular incorporation use.
Due to the application technique (soil incorporation when sowing), foraging bees will not be significantly exposed directly to the granules. Carbosulfan and its metabolites are transported systematically from the plant roots to the pollen and nectar. In the case of an extension of the use to blooming crops, the notifier should provide detailed information and further assessment of the risk to pollinating insects.

		However, the risk to bees for the supported use is acceptable since the exposure to carbosulfan in sugar beets is not relevant. Sugar beet is not attractive for pollinating insects (no flower in the production crop). In conclusion, the risk of carbosulfan and carbofuran is acceptable for the intended use. (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2009), p101) **<u>CILSS Countries</u>** (hazard data provided): Carbosulfan is highly toxic to bees (LD_{50} 48h = 0.18 µg/bee) (UNEP/FAO/RC/CRC.11/INF/15.En, SPC (2014), p3)
5.4	**Earthworms**	**<u>European Union</u>** The risk to earthworms was assessed based on results from a field study performed with the formulation MARCHAL 25 CS at an application rate of 1.3 kg a.s./ha which is above the proposed application rate in maize and sugar beet. Reduction of earthworm populations (number of adult worms, biomass) were observed 1 month after application of carbosulfan. Recovery was observed 6 and 12 months after application. No studies are available with the granular formulation MARCHAL 10 G. It was questioned in the experts' meeting whether the study with MARCHAL 25 CS could be used to assess the risk from the granular formulation and this needs to be clarified before a final conclusion on the risk to earthworms can be drawn for the use in maize and sugar beet. No studies with soil organisms are available for the metabolite 3-keto carbofuran. The risk needs to be addressed since the active moiety is retained and the metabolite is persistent in acidic soils. Neither are studies with soil organisms available with the metabolite dibutylamine. For this metabolite studies are however not considered necessary since the metabolite does not contain the active moiety. (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2006), p32) **<u>CILSS Countries</u>** No information provided on risks to earthworms.
5.5	**Soil microorganisms**	**<u>European Union</u>** The studies with carbosulfan available in the original Draft Assessment Report were not considered acceptable. A study with MARCHAL 10 G was submitted in July 2005. The results were reported in the addendum of May 2006 but have not been peer reviewed. The rapporteur Member State considered the risk to be low. The impact from the metabolite carbofuran on soil nitrogen turnover and soil respiration rate after 28 days is <25% compared to the control. The risk assessment for soil non-target micro-organisms can only be finalised after a full evaluation of the new study. (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2006), p32) **<u>CILSS Countries</u>** No information provided on risks to soil microorganisms.

5.6	**Summary – overall risk evaluation**	**<u>European Union</u>** It was concluded that carbosulfan was not demonstrated to fulfil the safety requirements laid down in Article 5 (1) (a) and (b) of Directive 91/414/EEC. The evaluation raised concerns regarding a possible risk to groundwater, due to a potential contamination of groundwater by the parent substance and by a number of relevant metabolites. In addition, the risk to birds and mammals, aquatic organisms, bees and earthworms could not be sufficiently assessed due to a lack of substantial data. Therefore, concerns remain as regards the risk assessment for these species. Additional data were available in the 2009 review which allowed addressing further elements of the risk assessment. There was a risk to birds and mammals from the uptake of residues in contaminated food items. Carbosulfan is toxic to bees and non-target arthropods although the risk was considered low for the representative uses that were evaluated. The risk to aquatic organisms, soil microorganisms and plants was considered low for the representative uses that were evaluated. (UNEP/FAO/RC/CRC.11/7) **<u>CILSS Countries</u>** In April 2015, on recommendation of the Sahelian Pesticides Committee, carbosulfan was banned by decision of the CILSS Coordinating Minister (Minister of Agriculture and Environment) due to unacceptable risk to the human health (difficulty to handle carbosulfan by users from Sahel Countries without risks) and non-target organisms in the environment. The ban of carbosulfan in several other countries such as the EU is also mentioned. (UNEP/FAO/RC/CRC.11/INF/15.En, SPC (2014), pp3-5) In the notifications, the following hazards to the environment are reported: carbosulfan is highly toxic to birds (LD_{50} *Anas platyrhynchos* = 10 mg/kg), fish (LC_{50} 96h *Lepomis macrochirus* = 0.015 mg/L), aquatic invertebrates (EC_{50} 48h *Daphnia magna* = 0.0032 mg/L) and bees (LD_{50} 48h = 0.18 µg/bee) (UNEP/FAO/RC/CRC.11/INF/15.En, SPC (2014), p3).

Annex 2 – Details on final regulatory actions reported

Country Name: European Union

1	**Effective date(s) of entry into force of actions**	Complete entry into force of all provisions of Commission Decision 2007/415/EC of 13 June 2007 is 13 December 2008 since all uses of plant products containing carbosulfan were prohibited as from that date at the latest.
	Reference to the regulatory document	Commission Decision 2007/415/EC of 13 June 2007 concerning the non-inclusion of carbosulfan in Annex I to Council Directive 91/414/EC and the withdrawal of authorisations for plant protection products containing that substance. (Official Journal of European Union, L 156/28,16.6.2007, p. 28-29) http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2007.156.01.0028.01.ENG&toc=OJ:L:2007:156:TOC
2	**Succinct details of the final regulatory action(s)**	It is prohibited to place on the market or use plant protection products containing carbosulfan. Carbosulfan is not included in the list of approved active substances under Regulation (EC) No 1107/2009, which replaces Directive 91/414/EEC. Authorisations for plant protection products containing carbosulfan had to be withdrawn by 13 December 2007. As of 16 June 2007 no authorisations for plant protection products containing carbosulfan were allowed to be granted or renewed by the Member States and all uses of plant protection products containing carbosulfan were prohibited as from 13 December 2008.
3	**Reasons for action**	Human health risks linked to certain metabolites and impurities as well as exceedance of the Acceptable Daily Intake by toddlers and risks to children and adults from consumption of a number of crops. Environmental risks linked to concerns for birds, mammals, aquatic organisms, bees and earthworms which could not be assessed due to lack of data. Carbosulfan was not demonstrated to fulfill the regulatory safety requirements.
4	**Basis for inclusion into Annex III**	The final regulatory action to ban carbosulfan was based on a risk evaluation taking into consideration local conditions in the EU Member States.
4.1	**Risk evaluation**	Human health: It was concluded that carbosulfan was not demonstrated to fulfil the safety requirements laid down in Article 5 (1) (a) and (b) of Directive 91/414/EEC. Certain metabolites with a hazardous profile appear with the use of carbosulfan. Some of these metabolites could be genotoxic. Due to uncertainties on this issue, and based on the current knowledge and the available data, risks regarding the exposure of consumer could not be excluded. In addition, impurities, of which at least one is carcinogenic (N-nitrosodibutylamine) were found in the substance as sold in the market (technical substance) at levels raising concerns. however a new specification submitted during a resubmission indicated this substance no longer exceeded the limit of 1mg/kg and concerns over this impurity could be considered as addressed (UNEP/FAO/RC/CRC.11/INF/14.En, EFSA (2009), p13). The further review in 2009 noted possible exceedance of the Acceptable Daily Intake by toddlers and acute risk to children and adults from consumption of a number of crops. Environment: It was concluded that carbosulfan was not demonstrated to fulfil the safety requirements laid down in Article 5 (1) (a) and (b) of Directive 91/414/EEC. The evaluation raised concerns regarding a possible risk to

		groundwater, due to a potential contamination of groundwater by the parent substance and by a number of relevant metabolites. In addition, the risk to birds and mammals, aquatic organisms, bees and earthworms could not be sufficiently assessed due to a lack of substantial data. Therefore, concerns remain as regards the risk assessment for these species. Additional data were available in the 2009 review which allowed addressing further elements of the risk assessment. There was a risk to birds and mammals from the uptake of residues in contaminated food items. Carbosulfan is toxic to bees and non-target arthropods although the risk was considered low for the representative uses that were evaluated. The risk to aquatic organisms, soil microorganisms and plants was considered low for the representative uses that were evaluated.
4.2	**Criteria used**	Risks to human health and the environment.
	Relevance to other States and Region	Similar health and environmental problems are likely to be encountered in other countries where the substance is used, particularly in developing countries.
5	**Alternatives**	None reported.
6	**Waste management**	None reported.
7	**Other**	None reported.

Country Name: Burkina Faso, Cabo Verde, Chad, the Gambia, Mauritania, the Niger, Senegal and Togo

1	**Effective date(s) of entry into force of actions**	08 April 2015
	Reference to the regulatory document	On recommendation of the Sahelian Pesticide Committee (SPC), Carbosulfan has been banned by decision of CILSS Coordinating Minister N007/MAE-MC/2015 of 8th April 2015.
2	**Succinct details of the final regulatory action(s)**	All products containing carbosulfan are banned due to their extremely high toxic potential to human health and especially the environment.
3	**Reasons for action**	Human Health risks which cited an instance of a poisoning in Burkina Faso linked to a pesticide containing carbosulfan and two other active ingredients. Environmental risks which cited the fragile ecology of CILSS countries and noted that carbosulfan metabolizes to carbofuran.
4	**Basis for inclusion into Annex III**	The final regulatory action to ban carbosulfan was based on a risk evaluation taking into consideration local conditions in the notifying countries.
4.1	**Risk evaluation**	Human Health: During a pilot study carried out in Burkina Faso in June 2010, through both retrospective and prospective surveys, 296 poisoning cases during the application of pesticides have been reported; only one Carbosulfan based formulation was involved in one poisoning case: PROCOT 40 WS, a tertiary formulation containing Carbosulfan (250 g/kg), Carbendazim (100 g/kg) and Metalaxyl- M (50 g/kg). It also came out from that study that no grower is granted medical check-up or healthcare related to the use of pesticides. Medical treatment and exams are left to the initiative of and at the expense of the growers. Furthermore, healthcare personnel have very little information on pesticides. 20 out of 42 persons in charge of heath care centres who had been interviewed had answered that they had no information on pesticides The low level of knowledge on pesticides is a significant handicap when dealing with poisoning cases.(the diagnosis not identifying the pesticide responsible for the accident, inadequate proposed therapy etc.) (Toe, 2010). Therefore, the absence of specialised training of medical staff leads to inadequate care in case of poisoning. In the whole, this survey showed that growers did not follow Good Agricultural Practices, in particular the use of appropriate personal protective equipment. Protective equipment (dust masks, boots and gloves in particular) is sold to the growers by distributors in 20% of cases. That equipment is not specific for field treatments. Growers mainly wear dust masks (39.08 % of cases) followed by boots (28.8 %) whereas overalls are the least used (4.5 %) during plant treatment. More than half of the growers (67.5 %) had a water source in their fields or nearby. Environment: The pilot study carried out in Burkina Faso showed that the majority of water points were less than 100m from the fields and this proximity may be at the origin of water pollution by pesticides. Water was being drunk in 50% of cases, it was used for the preparation or dilution of pesticides in 29.26 % and used for animal drinking in 26.96 % (Toe, 2010).

		To conclude, this pilot study showed that environment pollution risk by chemical pesticides such as carbosulfan is high. The Sahelian Pesticides Committee has stopped the registration of carbosulfan-based pesticides in CILSS countries in 2006 taking into account: • The fragile ecology of CILSS countries already characterized by an imbalance of • ecosystems and the disappearance of organisms useful to the environment; • Non-compliance with recommended measures for a safe use of carbosulfan by users in • the context of CILSS countries; • The low utilization rate of protective equipment by growers; • The existence of alternatives to the use of carbosulfan.
4.2	**Criteria used**	Risks to human health and the environment.
	Relevance to other States and Region	This measure will be of great interest to other Sahel countries which use the product under the same conditions.
5	**Alternatives**	Alternatives to the use of carbosulfan based formulations do exist. As an alternative, there are insecticide/acaricide formulations which are registered and authorized for sale in CILSS countries. There are at least ten insecticide/acaricide formulations in the general list of pesticides registered by SPC for corn, sugar cane, vegetables (SPC, 2014). These are chlorpyrifos-5 ethyl, profenofos, cypermethrine, ethoptophos, abamectine, deltamethrine and lambda-cyhalothrine based formulations.
6	**Waste management**	None reported.
7	**Other**	It has frequently caused the poisoning of users and consumers of treated products in the past. It continues to pollute the environment long after its use. Furthermore, Carbosulfan has been banned in the European Union since 2008 because of its toxicity.

Annex 3 – Addresses of designated national authorities

European Union

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Burkina Faso

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Cabo Verde

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Chad

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Gambia

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Annex 4 – References

Regulatory actions

European Union:

Commission Decision 2007/415/EC of 13 June 2007 concerning the non-inclusion of carbosulfan in Annex I to Council Directive 91/414/EC and the withdrawal of authorisations for plant protection products containing that substance. (Official Journal of European Union, L 156/28,16.6.2007, p. 28-29). Available at: http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32007D0415

CILSS countries:

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