National Institute
for Public Health
and the Environment

Report 601714001/2008

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This investigation has been performed for the account of the Directorate-General for Environmental Protection, Directorate for Soil, Water and Rural Area (BWL), in the context of the project 'Standard setting for other relevant substances within the WFD', RIVM-project no. M/601714/07/AH

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Rapport in het kort

Milieurisicogrenzen voor dimethoaat

Het RIVM heeft in dit rapport milieurisicogrenzen afgeleid voor dimethoaat in water. Dimethoaat is een organofosforverbinding die als insecticide wordt gebruikt in de land- en tuinbouw. De Internationale Commissie voor Bescherming van de Rijn (ICBR) heeft deze stof geselecteerd als Rijnrelevante stof onder de Kaderrichtlijn Water. Voor de afleiding van de milieurisicogrenzen heeft het RIVM de meest actuele milieuchemische en toxicologische gegevens gebruikt. Dit heeft ertoe geleid dat het berekende maximaal toelaatbare risiconiveau (MTR) in zoet oppervlaktewater daalt van 23 naar 0,07 µg/L. Voor het sedimentcompartiment heeft het RIVM geen milieurisicogrenzen afgeleid, omdat binding van de stof aan het sediment verwaarloosbaar wordt geacht.

De afleiding is uitgevoerd volgens de methodiek voor afleiding van milieurisicogrenzen zoals voorgeschreven door de Europese Kaderrichtlijn Water. Milieurisicogrenzen vormen de wetenschappelijke basis waarop de interdepartementale Stuurgroep Stoffen de milieukwaliteitsnormen vaststelt. De overheid hanteert deze normen bij de uitvoering van het nationale stoffenbeleid en de Europese Kaderrichtlijn Water. Er bestaan vier verschillende niveaus voor milieurisicogrenzen: een verwaarloosbaar risiconiveau (VR), een niveau waarbij geen schadelijke effecten zijn te verwachten (MTR), het maximaal aanvaardbare niveau voor ecosystemen, specifiek voor kortdurende blootstelling (MAC_{eco}) en een niveau waarbij mogelijk ernstige effecten voor ecosystemen zijn te verwachten (ER_{eco}).

Trefwoorden: milieukwaliteitsnormen; milieurisicogrenzen; dimethoaat; maximaal toelaatbaar risiconiveau; verwaarloosbaar risiconiveau

Abstract

Environmental risk limits for dimethoate

This report documents the RIVM's derivation of environmental risk limits for dimethoate in water. Dimethoate is an organophosphorus compound that is used as an insecticide in agriculture. The International Commission for the Protection of the Rhine (ICPR) has selected this compound as a Rhine-relevant substance within the Water Framework Directive. The RIVM used the most recent ecotoxicological and environmental fate data for deriving the Maximum Permissible Concentration (MPC). This resulted in a reduction of the calculated MPC for fresh surface water from 23 to 0.07 µg/L. No risk limits were derived for the sediment compartment because binding of the substances to sediment is considered to be negligible.

The derivation procedure followed the methodology for the derivation of environmental risk limits as required by the European Water Framework Directive. Environmental risk limits form the scientific basis on which the interdepartmental steering group 'substances' sets the environmental quality standards. The government uses these quality standards for carrying out the national policy concerning substances and the European Water Framework Directive. Four different levels are distinguished: negligible concentrations (NC); a level at which no harmful effects are to be expected (maximum permissible concentration: MPC); the maximum acceptable concentration for ecosystems specifically for short-term exposure (MAC_{eco}) and a level at which possible serious effects are to be expected (serious risk concentrations: SRC_{eco}).

Key words: environmental risk limits, dimethoate, maximum permissible concentrations, maximum acceptable concentration, negligible concentration.

Preface

The aim of this report is to derive risk limits that protect not only the environment but man as well. This is done in accordance with the methodology of the Water Framewerk Directive (WFD) that is incorporated in the present methodology for 'International and national environmental quality standards for substances in the Netherlands' (INS), following the 'Guidance for the derivation of environmental risk limits within the framework of INS' (Van Vlaardingen and Verbruggen, 2007).

The results presented in this report have been discussed by the members of the scientific advisory group for the INS-project (WK-INS). This advisory group provides a non-binding scientific comment on the final draft of a report in order to advise the interdepartmental Steering Committee for Substances on the scientific merits of the report.

Contents

Samenvatting

Milieurisicogrenzen worden afgeleid met gebruik van ecotoxicologische, fysisch-chemische en humaan toxicologische gegevens en representeren het potentiële risico van stoffen in het milieu voor mens en ecosysteem. Zij vormen de wetenschappelijke basis voor milieukwaliteitsnormen die worden vastgesteld door de Stuurgroep Stoffen.

In dit rapport zijn de milieurisicogrenzen Verwaarloosbaar Risiconiveau (VR), Maximaal Toelaatbaar Risiconiveau (MTR, ook wel MPC of voorstel AA-EQS genoemd), Maximaal Acceptabele Concentratie voor ecosystemen (MAC_{eco} of voorstel MAC-EQS) en Ernstig Risiconiveau voor ecosystemen (ER_{eco}) afgeleid voor dimethoaat in water. Voor het sedimentcompartiment zijn geen risicogrenzen afgeleid omdat binding aan het sediment verwaarloosbaar wordt geacht.

Voor het afleiden van het MTR en de MAC_{eco} voor water is gebruikgemaakt van de veiligheidsfactoren in overeenstemming met de Kaderrichtlijn Water. Deze veiligheidsfactoren zijn gebaseerd op het EU richtsnoer voor de risicobeoordeling van nieuwe stoffen, bestaande stoffen en biociden (European Commission (Joint Research Centre), 2003). Voor ER_{eco} en VR is de handleiding voor het project (Inter)Nationale Normen Stoffen (INS) gebruikt (Van Vlaardingen en Verbruggen, 2007). Voor een overzicht van de afgeleide milieurisicogrenzen, zie Tabel 1.

Tabel 1. Afgeleide MTR's, MAC's$_{eco}$, VR's en ER's$_{eco}$ (in µg.L^{-1}) voor dimethoaat in zoet- en zoutwater (respectievelijk 'water' en 'marien').

Stof	MTR $_{eco, water}$ [1]	MTR $_{dw, water}$ [1]	MTR $_{sp, water}$ [1]	MTR $_{hh food, water}$ [1]	MTR $_{eco, marien}$ [2]	VR $_{water}$ [3]	VR $_{marien}$ [3]	MAC $_{eco, water}$	ER $_{eco, water}$
Dimethoaat	0,07	0,1	n.a.[4]	n.a.[4]	0,007	$7{,}0 \times 10^{-4}$	$7{,}0 \times 10^{-5}$	0,7	$3{,}5 \times 10^{3}$

[1] In het voorstel voor de dochter richtlijn Prioritaire Stoffen, baseert de Europese Commissie de afleiding van het MTR_{water} op directe blootstelling, doorvergiftiging en humane blootstelling als gevolg van visconsumptie. Drinkwater is niet opgenomen in dit voorstel en daardoor niet leidend voor het overkoepelende MTR. Het $MTR_{dw, water}$ heeft betrekking op oppervlaktewater bedoeld voor de inname van drinkwater, maar de wijze waarop dit zal worden geïmplementeerd in Nederland is momenteel onderwerp van discussie in het kader van de "AMvB Waterkwaliteitseisen en Monitoring Water". Een definitieve beslissing is nog niet genomen. Het $MTR_{dw, water}$ wordt in dit rapport daarom als een aparte waarde gepresenteerd. Het uiteindelijke MTR_{water} wordt dus bepaald door de laagste van de afgeleide waarden op basis van directe blootstelling ($MTR_{eco, water}$), doorvergiftiging ($MTR_{sp, water}$) en humane visconsumptie ($MTR_{hh food, water}$). Gezien de eigenschappen van de stof, zijn de laatste twee echter niet van toepassing op dimethoaat.
[2] In het startdocument voor de bijeenkomst van de expertgroep 'qualitätsziele' (EG-Squa) van de Internationale Commissie ter Bescherming van de Rijn (ICBR) van maart 2007 is de waarde van 0,07 µg/L voorgesteld voor de MTR_{marien}. Echter, bij het maken van het huidige rapport is een extra factor van 10 nodig geacht, gebaseerd op de Fraunhofer handleiding (Lepper, 2005).
[3] Voor de berekening van het VR_{water} is het laagste MTR_{water} gebruikt.
[4] n.a. = niet afgeleid

Summary

Environmental risk limits are derived using ecotoxicological, physicochemical, and human toxicological data. They represent potential risks of substances to ecosystems and form the scientific basis for setting environmental quality standards by the Steering Committee for Substances.

In this report, the risk limits Negligible Concentration (NC), Maximum Permissible Concentration (MPC), Maximum Acceptable Concentration for ecosystems (MAC_{eco}), and Serious Risk Concentration for ecosystems (SRC_{eco}) are derived for dimethoate in water. No risk limits were derived for the sediment compartment because exposure of sediment is considered negligible.

For the derivation of the MPC and MAC_{eco} for water, extrapolation factors were used in accordance with the Water Framework Directive. These factors are based on the Technical Guidance Document on risk assessment for new and existing substances and biocides (European Commission (Joint Research Centre), 2003). For the NC and the SRC_{eco}, the guidance developed for the project 'International and National Environmental Quality Standards for Substances in the Netherlands' was used (Van Vlaardingen and Verbruggen, 2007). An overview of the derived environmental risk limits is given in Table 2.

Table 2. MPCs, NCs, MAC_{eco}, and SRC_{eco} (in µg.L^{-1}) derived for dimethoate.

Substance	**MPC** $_{eco, water}$ [1]	**MPC** $_{dw, water}$ [1]	**MPC** $_{sp, water}$ [1]	**MPC** $_{hh\ food, water}$ [1]	**MPC** $_{eco, marine}$ [2]	**NC** $_{water}$ [3]	**NC** $_{marine}$ [3]	**MAC** $_{eco, water}$	**SRC** $_{eco, water}$
Dimethoate	0.07	0.1	n.d.[4]	n.d.[4]	0.007	7.0×10^{-4}	7.0×10^{-5}	0.7	3.5×10^{3}

[1] In the proposal for the daughter directive Priority Substances, the European Commission based the derivation of the AA-EQS (= MPC) on direct exposure, secondary poisoning, and human exposure due to the consumption of fish. Drinking water was not included in the proposal and is thus not guiding for the general MPC value. The $MPC_{dw, water}$ relates to surface water intended for the abstraction of drinking water. The exact way of implementation of the $MPC_{dw, water}$ in the Netherlands is at present under discussion within the framework of the "AMvB Waterkwaliteitseisen en Monitoring Water". No policy decision has been taken yet, and the $MPC_{dw, water}$ is therefore presented as a separate value in this report. The MPC_{water} is thus derived considering the individual MPCs based on direct exposure ($MPC_{eco, water}$), secondary poisoning ($MPC_{sp, water}$) or human consumption of fishery products ($MPC_{hh\ food, water}$). Derivation of the latter two is, however, not applicable to dimethoate in view of the characteristics of the compound.
[2] In the initial document for the meeting of the expertgroup 'qualitätsziele' (EG-Squa) of the International Commision for the Protection of the Rhine (ICPR) in March 2007, the value of 0.07 µg.L^{-1} was proposed for the $MPC_{eco, marine}$. However, in finalising this report an additional factor of 10 for the marine environment was considered necessary, based on the FHI guidance.
[3] For the calculation of NC_{water} the lowest MPC_{water} has been used.
[4] n.d. = not derived

List of abbreviations and variables

ADI	Acceptable Daily Intake	$mg.kg_{bw}^{-1}.d^{-1}$
ERL	Environmental Risk Limit	
INS	International and National Environmental Quality Standards for Substances in the Netherlands	
MAC_{eco}	Maximum Acceptable Concentration for ecosystems	$\mu g.L^{-1}$
$MAC_{eco, water}$	Maximum Acceptable Concentration for freshwater ecosystems	$\mu g.L^{-1}$
$MAC_{eco, marine}$	Maximum Acceptable Concentration for marine ecosystems	$\mu g.L^{-1}$
MPC	Maximum Permissible Concentration	$\mu g.L^{-1}$
MPC_{water}	Maximum Permissible Concentration in water	$\mu g.L^{-1}$
$MPC_{dw, water}$	Maximum Permissible Concentration in water based on abstraction of drinking water	$\mu g.L^{-1}$
$MPC_{eco, water}$	Maximum Permissible Concentration in water based on ecotoxicological data	$\mu g.L^{-1}$
$MPC_{hh\ food, water}$	Maximum Permissible Concentration in water based on consumption of fish and shellfish by humans	$\mu g.L^{-1}$
$MPC_{sp, water}$	Maximum Permissible Concentration in water based on secondary poisoning	$\mu g.L^{-1}$
MPC_{marine}	Maximum Permissible Concentration in saltwater (transitional, coastal, and territorial waters)	$\mu g.L^{-1}$
$MPC_{eco, marine}$	Maximum Permissible Concentration in saltwater based on ecotoxicological data	$\mu g.L^{-1}$
$MPC_{sp, marine}$	Maximum Permissible Concentration in saltwater based on secondary poisoning	$\mu g.L^{-1}$
NC	Negligible Concentration	$\mu g.L^{-1}$
SRC_{eco}	Serious Risk Concentration for ecosystems	$\mu g.L^{-1}$
TDI	Tolerable Daily Intake	$mg.kg_{bw}^{-1}.d^{-1}$
TGD	Technical Guidance Document on risk assessment	
TL_{hh}	Threshold Level for human health	$mg.kg_{bw}^{-1}.d^{-1}$
WFD	Water Framework Directive (2000/60/EC)	

1. Introduction

1.1 Project framework

In this report, environmental risk limits (ERLs) for surface water (freshwater and marine) are derived for dimethoate. The derivation is performed within the framework of the project 'Standard setting for other relevant substances within the WFD', which is closely related to the project 'International and national environmental quality standards for substances in the Netherlands' (INS). Dimethoate is selected by the Netherlands within the scope of the Water Framework Directive (WFD; directive number 2000/60/EC). The substance is considered relevant for the river Rhine basin district.

The following ERLs are considered:

- Negligible Concentration (NC) – concentration at which effects to ecosystems and humans are expected to be negligible. The NC is derived by dividing the MPC (see next bullet) by a factor of 100.
- Maximum Permissible Concentration (MPC) – concentration at which ecosystems and humans are protected from adverse effects.
- Maximum Acceptable Concentration (MAC_{eco}) – concentration protecting aquatic ecosystems for effects due to short-term exposure or concentration peaks.
- Serious Risk Concentration (SRC_{eco}) – concentration at which ecosystem functions will be seriously affected.

1.2 Status of the results

The results presented in this report have been discussed by the members of the scientific advisory group for the INS-project (WK-INS). It should be noted that the Environmental Risk Limits (ERLs) in this report are scientifically derived values, based on (eco)toxicological, fate and physico-chemical data. They serve as advisory values for the Dutch Steering Committee for Substances, which is appointed to set the Environmental Quality Standards (EQSs). ERLs should thus be considered as preliminary values that do not have any official status.

2. Methods

2.1 Guidance followed for this project

The ERLs are derived following the methodology of the project 'International and National Environmental Quality Standards for Substances in the Netherlands' (INS) (Van Vlaardingen and Verbruggen, 2007). This updated INS guidance is in accordance with the guidance by Lepper (2005) which forms part of the Priority Substances Daughter Directive (2006/0129 (COD)) amending the WFD (2000/60/EC). The WFD guidance applies to the derivation of MPCs for water and sediment. ERL derivations for water and sediment are performed for both the freshwater and marine compartment. The WFD guidance introduces a new ERL, which is the Maximum Acceptable Concentration (MAC_{eco}), a concentration that protects aquatic ecosystems from adverse effects caused by short-term exposure or concentration peaks. Further, two MPC values are considered for the water compartment that are based on a human toxicological risk limit (TL_{hh}), which might be an ADI or TDI, etc. Discerned are (1) the $MPC_{hh\ food,\ water}$, which is the concentration in water that should protect humans against adverse effects from the substance via fish and shellfish consumption; (2) the $MPC_{dw,\ water}$, which is the concentration in water that should protect humans against adverse effects of the substance after abstraction of drinking water. Note that each of these two MPCs is allowed to contribute only 10% to the TL_{hh}. Two other MPCs are considered for the water compartment, based on ecotoxicological data. These are (1) the $MPC_{eco,\ water}$, which refers to direct exposure and is based on aquatic ecotoxicity data and (2) the $MPC_{sp,\ water}$ which accounts for potential effects on birds or mammals due to secondary poisoning. The MPC and NC derivation thus integrates both ecotoxicological data and a human toxicological threshold value, under provision that the need for derivation of the $MPC_{hh\ food,\ water}$ and $MPC_{sp,\ water}$ depends on the characteristics of the compound.

2.2 Data collection

In accordance with the WFD, data of existing evaluations were used as a starting point. For pesticides, the evaluation report prepared within the framework of EU Directive 91/414/EC (Draft Assessment Report, DAR) was consulted (European Commission, 2003). An on-line literature search was performed on TOXLINE (literature from 1985 to 2001) and Current contents (literature from 1997 to 2006). The methodology of data search, data selection and ERL derivation, is described in Van Vlaardingen and Verbruggen (2007). The search resulted in approximately 800 references, of which more than 120 references were considered relevant. In addition to this, all references in the RIVM e-tox base and EPA's ECOTOX database were evaluated (an additional 60 references).

2.3 Data evaluation and selection

For substance identification, physico-chemical properties and environmental behaviour, information from IUCLID, 2000, the DAR (European Commission, 2003), the e-Pesticide Manual (Tomlin, 2002) and Mackay *et al.*, (2000) were used. Information on human toxicological threshold limits and classification was primarily taken from the DAR.
Ecotoxicity studies were screened for relevant endpoints (i.e. those endpoints that have consequences at the population level of the test species). All ecotoxicity and bioaccumulation tests were then thoroughly evaluated with respect to the validity (scientific reliability) of the study. A

detailed description of the evaluation procedure is given in Van Vlaardingen and Verbruggen, (2007). In short, the following Reliability indices (Ri) were assigned (based on Klimisch et al., 1997):

- Ri 1: Reliable without restriction
  'Studies or data … generated according to generally valid and/or internationally accepted testing guidelines (preferably performed according to GLP) or in which the test parameters documented are based on a specific (national) testing guideline … or in which all parameters described are closely related/comparable to a guideline method.'
- Ri 2: Reliable with restrictions
  'Studies or data … (mostly not performed according to GLP), in which the test parameters documented do not totally comply with the specific testing guideline, but are sufficient to accept the data or in which investigations are described which cannot be subsumed under a testing guideline, but which are nevertheless well documented and scientifically acceptable.'
- Ri 3: Not reliable
  'Studies or data … in which there are interferences between the measuring system and the test substance or in which organisms/test systems were used which are not relevant in relation to the exposure (e.g., unphysiologic pathways of application) or which were carried out or generated according to a method which is not acceptable, the documentation of which is not sufficient for an assessment and which is not convincing for an expert judgment.'
- Ri 4: Not assignable
  'Studies or data … which do not give sufficient experimental details and which are only listed in short abstracts or secondary literature (books, reviews, etc.).'

All available studies were summarised in data-tables, that are included as Appendices to this report. These tables contain information on species characteristics, test conditions and endpoints. Explanatory notes are included with respect to the assignment of the reliability indices.

Endpoints with Ri 1 or 2 are accepted as valid, but this does not automatically mean that the endpoint is selected for the derivation of ERLs. The validity scores are assigned on the basis of scientific reliability, but valid endpoints may not be relevant for the purpose of ERL-derivation (e.g. due to inappropriate exposure times or test conditions that are not relevant for the Dutch situation). After data collection and validation, toxicity data were combined into an aggregated data table with one effect value per species. When for a species several effect data were available, the geometric mean of multiple values for the same endpoint was calculated where possible. Subsequently, when several endpoints were available for one species, the lowest of these endpoints (per species) is reported in the aggregated data table.

2.4 Derivation of ERLs

For a detailed description of the procedure for derivation of the ERLs, reference is made to Van Vlaardingen and Verbruggen (2007). Some additional comments should be made with respect to the final MPC_{water}:

2.4.1 Drinking water

In the proposal for the daughter directive Priority Substances, the European Commission based the derivation of the AA-EQS (= MPC) on direct exposure, secondary poisoning, and human exposure due to the consumption of fish. Drinking water was not included in the proposal and the $MPC_{dw, water}$, which relates to surface water intended for the abstraction of drinking water, is thus not guiding for the general MPC value. The exact way of implementation of the $MPC_{dw, water}$ in the Netherlands is at present under discussion within the framework of the "AMvB Waterkwaliteitseisen en Monitoring Water". No policy decision has been taken yet, and the $MPC_{dw, water}$ is therefore presented as a separate value in this report. The MPC_{water} is thus derived

considering the individual MPCs based on direct exposure ($MPC_{eco, water}$), secondary poisoning ($MPC_{sp, water}$) or human consumption of fishery products ($MPC_{hh\ food, water}$). Derivation of the latter two, however, is not applicable to dimethoate in view of the characteristics of the compound.

2.4.2 Total or dissolved concentration

The WFD guidance departs from the viewpoint that laboratory toxicity tests contain suspended matter in such concentrations, that results based on laboratory tests are comparable to outdoor surface waters. In other words: each outcome of an ERL derivation for water will now result in a total concentration. This differs from the former Dutch approach, in which each outcome of a laboratory test was considered to represent a dissolved concentration. The dissolved concentration was then recalculated to a total concentration using standard characteristics for surface water and suspended matter. This recalculation is no longer made within INS framework.

3. Substance identification, physico-chemical properties, fate and human toxicology

3.1 Identity

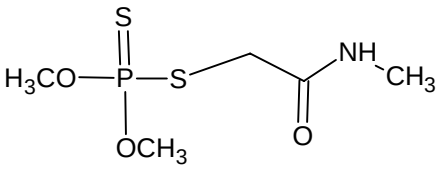

Figure 1. Structural formula of dimethoate.

Table 3. Identification of dimethoate.

Parameter	Name or nr.	Source
Chemical name	O,O-dimethyl S-methylcarbamoylmethyl phosphorodithioate	IUPAC name
Common/trival/ other name	Dimethoate, Phosphamid, Rogor, Roxion, Perfekthion, Cygon, Dimeton	Mackay *et al.*, 2000
CAS nr.	60-51-5	
EC nr.	200-480-3	
SMILES code	S=P(SCC(=O)NC)(OC)OC	

3.2 Physico-chemical properties

Table 4. Selected physico-chemical properties of dimethoate.

Parameter	Unit	Value	Remark	Reference
Molecular weight	[g.mol^{-1}]	229.28		Mackay *et al.*, 2000
Water solubility	[g.L^{-1}]	23.8 23.3/25.0 39.8 20	pH 7; 20 °C pH 5/pH 9 Selected; more data available.	Tomlin, 2002 IUCLID, 2000 European Commission, 2003 Mackay *et al.*, 2000
pK_a	[-]	n.a.		
log K_{ow}	[-]	0.78 0.70	Selected; more data available.	Mackay *et al.*, 2000; MlogP IUCLID, 2000; Tomlin, 2002
log K_{oc}	[-]	1.3	Soil, 20-25 °C; Selected; more data available.	Mackay *et al.*, 2000
Vapour pressure	[Pa]	2.5×10^{-4}		European Commission, 2003
Melting point	[°C]	52 49 45-51	Selected; more data available.	Mackay *et al.*, 2000 Tomlin, 2002 IUCLID, 2000
Boiling point	[°C]	117		Tomlin, 2002; IUCLID, 2000
Henry's law constant	[Pa.m^3.mol^{-1}]	1.15×10^{-4} 1.2×10^{-6}	Calculated-P/C	Mackay *et al.*, 2000 Tomlin, 2002

n.a. = not applicable.

3.3 Behaviour in the environment

Table 5. Selected environmental properties of dimethoate.

Parameter	Unit	Value	Remark	Reference
Hydrolysis half-life	DT50 [d]	156 68 4.4	pH 5; 25 ºC pH 7; 25 ºC pH 9; 25 ºC	IUCLID, 2000
Photolysis half-life	DT50 [d]	>175		IUCLID, 2000
Readily biodegradable		no	OECD 301	European Commission, 2003
Degradation water/sediment	DT50 [d]	12-17		IUCLID, 2000
Soil	DT50 [d]	2-4 22	aerobic anaerobic	IUCLID, 2000
Relevant metabolites		O-destmethyl dimethoate O,O-dimethyl phophorothioate O,O-dimethyl phosphate omethoate		

3.4 Bioconcentration and biomagnification

Table 6. Overview of bioaccumulation data of dimethoate. Details are specified in Appendix 2.

Parameter	Unit	Value	Remark	Reference
BCF (fish)	[$L.kg^{-1}$]	<1 0.1 0.23 0.07	Whole fish Branchial tissue Fish liver Fish muscle	Canton *et al.*, 1980 Begum *et al.*, 1997 Begum *et al.*, 1994 Idem
BCF (mussel)	[$L.kg^{-1}$]	0.3 0.39		Serrano *et al.*, 1995 Idem
BMF	[$kg.kg^{-1}$]	1	Default value for BCF < 2000 $L.kg^{-1}$	

3.5 Human toxicological threshold limits and carcinogenicity

Dimethoate has not been classified as carcinogenic to humans. The main effect of dimethoate to mammals is inhibition of cholinesterase activity. An effect on survival of offspring in rats has also been reported, but this is assumed to be an effect of behavioural changes due to cholinesterase inhibition in rat mothers. In a human-toxicological volunteer study, a NOEC based on cholinesterase inhibition was measured to be 0.202 $mg.kg_{bw}^{-1}.d^{-1}$, on which an ADI of 0.002 $mg.kg_{bw}^{-1}.d^{-1}$ was based (European Commission, 2003).

4. Trigger values

This section reports on the trigger values for ERL_{water} derivation (as demanded in WFD framework).

Table 7. Dimethoate: collected properties for comparison to MPC triggers.

Parameter	Value	Unit	Derived at page nr.	Method/source (if applicable)
Log $K_{p,\ susp\text{-}water}$	0.3	[-]		$K_{oc} \times f_{oc,susp}$ [1]
BCF	<1	[L.kg^{-1}]	15	
BMF	1	[kg.kg^{-1}]	15	Default value for BCF < 2000 L.kg^{-1}
Log K_{ow}	0.78 0.70	[-]		Mackay *et al.*, 2000; MlogP IUCLID, 2000; Tomlin, 2002
R-phrases	Xn; R21/22 Xn; R21/22; N; R51/53	[-]		http://ecb.jrc.it/esis/ European Commission, 2003
A1 value	1	[µg.L^{-1}]		Total pesticides
DW Standard	0.1	[µg.L^{-1}]		General value for organic pesticides

[1] $f_{OC,susp}$ = 0.1 $kg_{OC}.kg_{solid}^{-1}$ (European Commission (Joint Research Centre), 2003).

- Dimethoate has a log $K_{p,\ susp\text{-}water}$ < 3; derivation of $MPC_{sediment}$ is not triggered.
- Dimethoate has a log $K_{p,\ susp\text{-}water}$ < 3; expression of the MPC_{water} as MPC in suspended particulate matter is not required.
- Dimethoate has a BCF < 100 L.kg^{-1}; assessment of secondary poisoning is not triggered.
- Dimethoate has an R21/22 and R51/53 classification. There is no classification for carcinogenic properties. Therefore, an MPC_{water} for human health via food (fish) consumption ($MPC_{hh\ food,\ water}$) does not have to be derived.
- For dimethoate, no specific A1 value or Drinking Water Standard is available from Council Directives 75/440, EEC and 98/83/EC, respectively. Therefore, the general Drinking Water Standard for organic pesticides applies.

5. Toxicity data and ERL derivation

5.1 ERL derivation for water

5.1.1 $MPC_{eco, water}$ and $MPC_{eco, marine}$

An overview of the selected freshwater and marine toxicity data for dimethoate is given in Appendix 3: Table A3.1 (freshwater, acute), A3.2 (marine, acute), A3.3 (freshwater, chronic) and A3.4 (marine, chronic). When for a species several effect data are available, where possible the geometric mean of multiple values for the same endpoint is calculated. Subsequently, when several endpoints are available, the lowest of these endpoints is reported in the aggregated data table in Appendix 1.

5.1.1.1 Combination of fresh- and saltwater data

For pesticides, MPCs for freshwater and other surface waters (marine and estuarine waters) should be derived separately. According to Lepper (2005): *'Freshwater effects data of plant protection products (PPP) shall normally not be used in place of saltwater data, because within trophic levels differences larger than a factor of 10 were found for several PPP. This means that for PPP the derivation of quality standards addressing the protection of water and sediment in transitional, coastal and territorial waters is not possible if there are no effects data for marine organisms available or if it is not possible to determine otherwise with high probability that marine organisms are not more sensitive than freshwater biota (consideration of the mode of action may be helpful in this assessment)'.* However, the dimethoate data show that marine species are not more sensitive than freshwater species. The only available data for marine species are from acute studies. These data are very similar to the acute toxicity data for freshwater species, and hence the difference is not significant. Further, all marine data lie within the range of acute toxicity data for freshwater species. Moreover, the most sensitive group of species (insects) does almost not occur in marine waters (only in estuarine and coastal waters). In the dataset, one saltwater insect species is present. This species is not more sensitive than the freshwater insects. Besides this species, not many saltwater insect species are known. Because of these reasons, for this environmental limit derivation fresh- and saltwater data are combined. The derivation itself, however, is not combined, because for the marine ERL Lepper (2005) states that '*where only data for freshwater or saltwater algae, crustaceans and fish are available a higher assessment factor than that used for the derivation of the inland water (freshwater) quality standard should be applied to reflect the greater uncertainty in the extrapolatio'*.

5.1.1.2 Mesocosm studies

A number of mesocosm studies are reported for dimethoate. The evaluation of these studies will be described in detail in Appendix 4. The NOECs reported in this section are determined by the authors of the present report, using the reported data, and are not the same as the NOECs reported by the authors of the considered publications. For stream-invertebrates (Baekken and Aanes, 1994), a NOEC of 1 $\mu g.L^{-1}$ was determined for structural differences which were measured for some populations, based on a nominal effect concentrations during 4 weeks. In freshwater enclosures an effect on phytoplankton biomass was measured at a chronic exposure of 0.95 $\mu g.L^{-1}$ during 16 days (mean measured concentration; Kallqvist *et al.*, 1994), resulting in a NOEC of < 0.95 $\mu g.L^{-1}$. For zooplankton also a NOEC of < 0.95 $\mu g.L^{-1}$ was determined after 15 days of exposure (Hessen *et al.*, 1994). Because effects were already reported at the lowest concentration tested (~ 1 $\mu g.L^{-1}$) and thus only 'lower-than' NOECs can be determined, no $MPC_{eco, water}$ can be derived using these

mesocosm studies. However, the studies can be used when the assessment factors for the derivation of the $MPC_{eco, water}$ have to be determined.

5.1.1.3 Derivation of $MPC_{eco, water}$ and $MPC_{eco, marine}$

$MPC_{eco, water}$

According to the guidance under the Water Framework Directive (Lepper, 2005), the derivation of the quality standard should discuss all possible methods: '*If preconditions are met to use the species sensitivity distribution method or the results of simulated ecosystem studies for the derivation of quality standards, these more sophisticated approaches should preferably be used to calculate standards. However, it is required to derive the same EQS as well with the AF-method for comparative purposes. Potential discrepancies in the results obtained with the different procedures need to be discussed and the decision for the finally preferred EQS derivation method be justified'.* Because in this case, both the statitistical extrapolation and mesocosms are relevant in addition to the assessment factors approach, the three methods will discussed consecutively.

Enough data are present to perform a statistical extrapolation (Species Sensitivity Distribution; SSD). The number and type of taxa satisfy the criteria. The HC_5 is 12.1 µg.L^{-1} (see Figure 2), with a 90% confidence interval of 0.942-67.8 µg.L^{-1}, and meets all statistical significance standards.

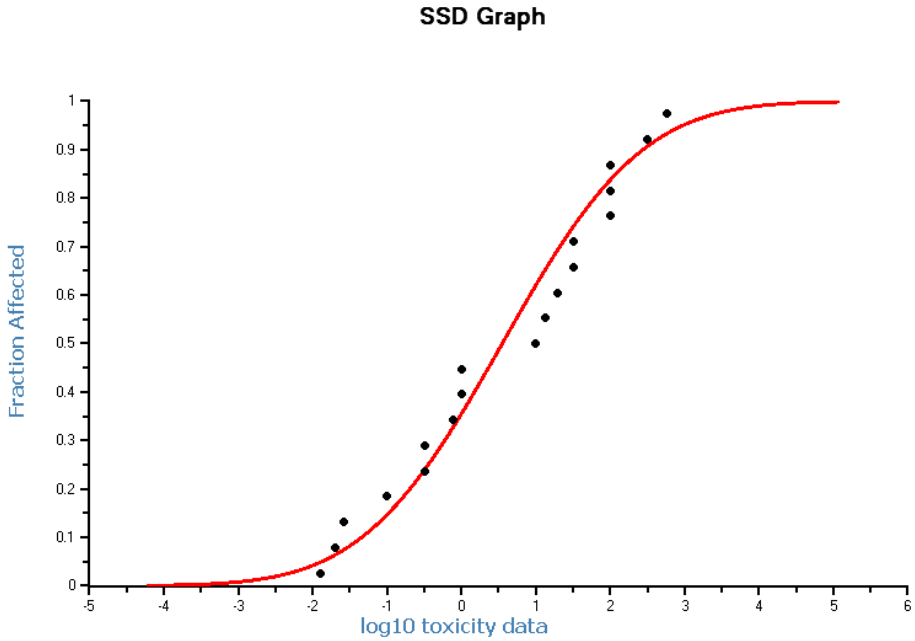

Figure 2. SSD for dimethoate based on chronic data.

The assessment factor for an SSD should be between 1 and 5, and a choice for a factor lower than 5 should be fully justified by the quality of the dataset (Lepper, 2005; Van Vlaardingen and Verbruggen, 2007). Aspects to take into consideration are: *'overall quality of the data…; the diversity and representativity of the taxonomic groups covered by the database…; knowledge on presumed mode of action of the chemical…; statistical uncertainties…; comparisons between field and mesocosm studies… '*. Many of the data for dimethoate are based on nominal concentrations, especially for the studies with the lowest effect concentrations. In the dataset for dimethoate only one NOEC of the most sensitive species (insects) is present, which is also relatively high. Besides this, the uncertainty in the calculated HC5 is considerable (the 90% confidence interval contains an

area with a factor of 72). Further, the mesocosm studies show already effects of dimethoate at 0.95 μg.L^{-1}. Thus, it is not possible to choose an assessment factor lower than 5. With an assessment factor of 5 on the HC5, the $MPC_{eco, water}$ for freshwater is 12.1/5 = 2.4 μg.L^{-1}.

The mesocosm studies show that this value is not protective enough since effects of dimethoate were already observed at 0.95 μg.L^{-1}. However, a no-effect level could not be derived from the available studies. Further, concrete guidance how to extrapolate from a no-effect level in a mesocosm study to the protection level of the MPC is lacking at this moment. Nevertheless, these mesocosm studies, that are assumed to give a better insight in the effects that might occur in the field, give additional useful information for the level where no effects in the environment are to be expected.

When deriving the $MPC_{eco, water}$ by the assessment factor approach the following rule applies (Lepper, 2005): *'An assessment factor of 50 …. also applies to the lowest of three NOECs covering three trophic levels when such NOECs have not been generated from that trophic level showing the lowest L(E)C50 in the short-term tests. This should however not apply in cases where the acutely most sensitive species has an L(E)C50 value lower than the lowest NOEC value. In such cases the PNEC might be derived by using an assessment factor of 100 to the lowest L(E)C50 of the short-term tests'*. The lowest NOEC available is 12.5 μg.L^{-1} for the fish *Brachydanio rerio* (Grande *et al.*, 1994); the lowest LC50 is 7 μg.L^{-1} for the insect *Baetis rhodani* (Baekken and Aanes, 1991). With an assessment factor of 100 the $MPC_{eco, water}$ is 7/100 = 0.07 μg.L^{-1}.

The $MPC_{eco, water}$ derived by statistical extrapolation is 2.4 μg.L^{-1}. However, in this approach data for the most sensitive group of species are not represented. The mesocosm studies indeed show effects at concentrations of 0.95 μg/L, but no $MPC_{eco, water}$ can be derived from these data, in the first place due to the absence of a no-effect level in two of the three studies. In the assessment factor approach the most sensitive species were included, which means that the $MPC_{eco, water}$ value from this approach is based on more data than those used for the species sensitivity distribution (acute and chronic instead of only chronic in the SSD). Therefore, the value derived by applying the assessment factor method is considered as the best basis for the $MPC_{eco, water}$. The $MPC_{eco, water}$ is thus 0.07 μg/L.

$MPC_{eco, marine}$

As outlined in section 5.1.1.1, the dataset for marine- and freshwater toxicity can be combined but the derivation should be performed separately. When deriving the $MPC_{eco, marine}$ using assessment factors, the the following rule applies (Lepper, 2005): '*…under no circumstances should a factor lower than 1000 be used in deriving a PNECwater for saltwaters from short-term toxicity data. […] in cases where the acutely most sensitive species has an L(E)C50 value lower than the lowest NOEC value. I n such cases the PNEC might be derived by using an assessment factor of 1000 to the lowest L(E)C50 of the short-term tests'*. The lowest NOEC available is 12.5 μg.L^{-1} for the fish *Brachydanio rerio* (Grande *et al.*, 1994); the lowest LC50 is 7 μg.L^{-1} for the insect *Baetis rhodani* (Baekken and Aanes, 1991).
With an assessment factor of 1000 the $MPC_{eco, marine}$ is 7/1000 = 0.007 μg.L^{-1}.

5.1.2 $MPC_{sp, water}$ and $MPC_{sp, marine}$

The derivation of a $MPC_{sp, water}$ and $MPC_{sp, marine}$ is not triggered because BCF < 100 L.kg^{-1}.

5.1.3 $MPC_{hh\ food,\ water}$

For dimethoate, there is no classification for carcinogenic and mutagenic properties or reproductive toxicity. Therefore, an MPC_{water} for human health via food (fish) consumption ($MPC_{hh\ food,\ water}$) does not have to be derived.

5.1.4 $MPC_{dw,\ water}$

According to the Drinking Water Standard (98/83/EG), a value of 0.1 $\mu g.L^{-1}$ should be applied for the protection of surface water intended for abstraction of drinking water.

5.1.5 Selection of the MPC_{water} and MPC_{marine}

As described in Section 2.4.1, the derivation of the final MPC_{water} is based on direct exposure ($MPC_{eco,\ water}$), secondary poisoning ($MPC_{sp,\ water}$), and human exposure due to the consumption of fish ($MPC_{hh\ food,\ water}$). Since secondary poisoning and human exposure via fish are not relevant for dimethoate, the lowest value of the routes included are the values for direct aquatic toxicity ($MPC_{eco,\ water}$). Therefore, the MPC_{water} is 0.07 $\mu g.L^{-1}$.

The only route included for the marine compartment is direct toxicity, the MPC_{marine} is 0.007 $\mu g.L^{-1}$.

5.1.6 MAC_{eco}

5.1.6.1 $MAC_{eco,\ water}$

The base set for acute data is complete. The BCF is smaller than 100 $L.kg^{-1}$. According to the guidance, for the derivation of the $MAC_{eco,\ water}$ an assessment factor of 100 should be used unless information on the mode of action is available and the interspecies variation is small. '*For substances with a known non-specific mode of action interspecies variations may be low and therefore a factor lower than 100 appropriate. Expert judgement and justification of the decision regarding the assessment factor chosen is therefore required. In no case should a factor lower than 10 be applied to a short-term L(E)C50 value'.* (Lepper, 2005). In the data set for dimethoate, the difference between LC50 values of the various species is 2.5×10^5. However, the data set is so large, that it is assumed that variation in sensitivity between species is adequately covered by the data. Besides, the mode of action is known (cholinesterase inhibition) and a relatively large number of LC50s are available for the sensitive species, which justifies an assessment factor of 10. The lowest LC50 is 7 $\mu g.L^{-1}$ for the insect *Baetis rhodani* (Baekken and Aanes, 1991), which gives a $MAC_{eco,\ water}$ for freshwater systems of 7 / 10 = 0.7 $\mu g.L^{-1}$.

By way of comparison, an SSD can also be performed for the acute data (Figure 3). Except for macrophytes the required set is complete. Because the chronic toxicity data for macrophytes show that this is not a sensitive species, the absence of this group will not affect the lowest values in the SSD directly, but it could affect the shape (slope) of the SSD curve. Because of this, the absence of macrophytes does influence the choice of the assessment factor to be used. The HC_5 for the acute SSD is 33.1 $\mu g.L^{-1}$, with a 90% confidence interval of 9.5-88.0 $\mu g.L^{-1}$. The HC5 meets the criteria at significance levels 0.025 and 0.01. An assessment factor fo 5 is justified because of (1) the absence of macrophyte data and (2) aqueous exposure concentrations of a large number of studies, mainly those with the lowest effect values, have not been measured. The $MAC_{eco,\ water}$ for freshwater systems would then be 33.1/5 = 6.62 $\mu g.L^{-1}$.

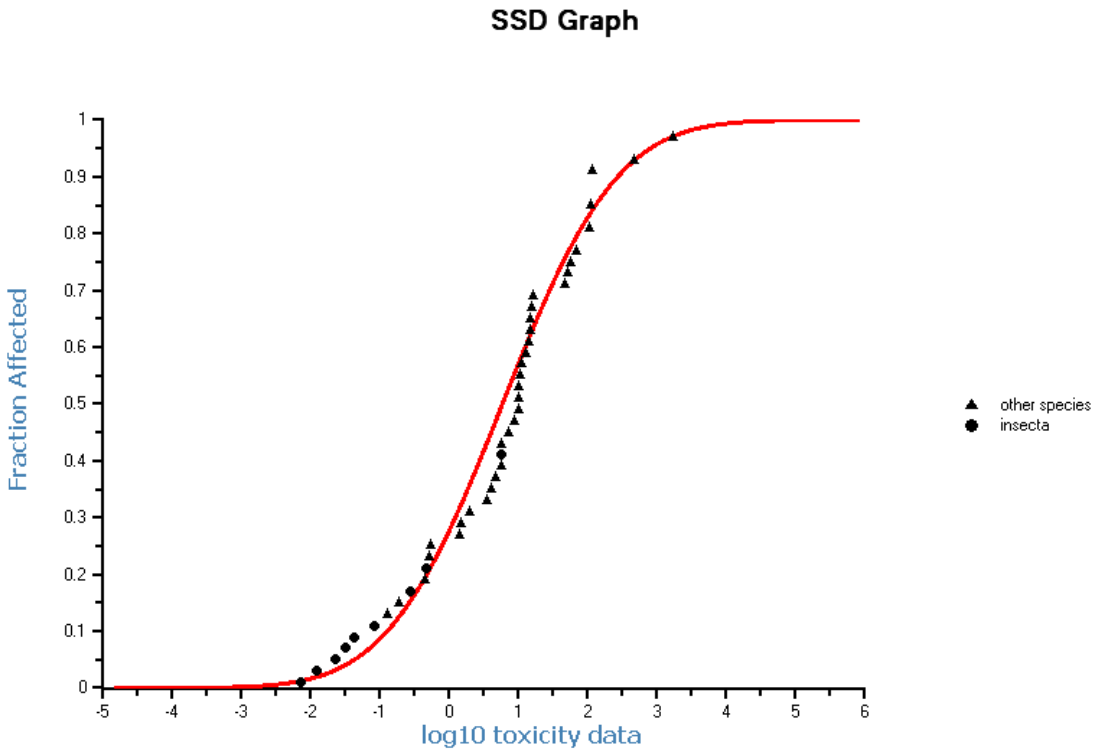

Figure 3. SSD for dimethoate based on acute data.

However, an SSD with only insect LC50s (Figure 4) gives an HC_5 of 2.25 µg.L^{-1}, which is below this $MAC_{eco, water}$, implying that the $MAC_{eco, water}$ based on an SSD with all species would not be protective for insects. The insect-based SSD can also be used to derive a $MAC_{eco, water}$ value. In this case, it is justified to deviate from the assessment factor of 5, because this SSD comprises only the sensitive species. The assessment factor should then be between 1 and 5 (Lepper, 2005; Van Vlaardingen and Verbruggen, 2007). In this case an assessment factor of 3 is chosen, because a large part of the concentrations of the studies used are not measured, and the number of datapoints/ insect species (9) is relatively limited. Using the insect-based SSD with an assessment factor of 3, the $MAC_{eco, water}$ would be 2.25 / 3 = 0.75 µg.L^{-1}, which is almost the same value which is derived above using the lowest LC50 (0.7 µg.L^{-1}). The $MAC_{eco, water}$ for freshwater systems is therefore set at 0.7 µg.L^{-1}.

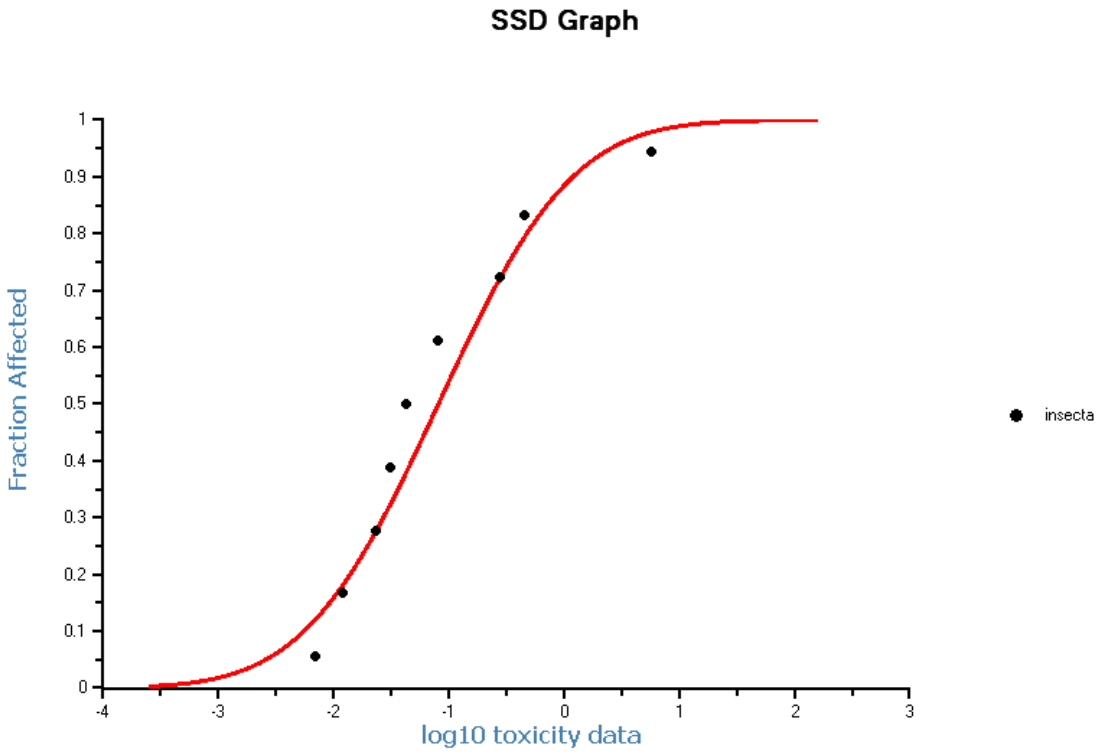

Figure 4. SSD for dimethoate based on acute data for insect species.

5.1.6.2 MACeco, marine

A $MAC_{eco,\ marine}$ can not be derived for the marine environment because no assessment factors are available (Lepper, 2005).

5.1.7 SRCeco

Since the required dataset is complete, the SRC_{eco} can be derived using the HC_{50} from the SSD with all chronic data (NOECs) with an assessment factor of 1. This HC_{50} is 3.53 $mg.L^{-1}$ (see Figure 2), with a 90% confidence interval of 0.92 - 13.6 $mg.L^{-1}$. Thus, the SRC_{eco} is 3.53 / 1 = 3.53 $mg.L^{-1}$.

5.1.8 NC

The negligible concentration (NC) is derived by dividing the derived MPCs by a factor of 100:
$NC_{water} = 7.0 \times 10^{-4}$ $\mu g.L^{-1}$.
$NC_{marine} = 7.0 \times 10^{-5}$ $\mu g.L^{-1}$.

5.2 ERL derivation for sediment

The log $K_{p,susp\text{-}water}$ of dimethoate is below the trigger value of 3, so $MPC_{sediment}$ values are not derived.

6. Conclusions

In this report, the Negligible Concentration (NC) and Maximum Permissible Concentration (MPCs) for freshwater and marine water, and the Maximum Acceptable Concentration for ecosystems (MAC_{eco}) and Serious Risk Concentration for ecosystems (SRC_{eco}) for water were derived for dimethoate. The sediment compartment was not taken into account because the trigger value of 3 for log $K_{p,\ susp\text{-}water}$ was not exceeded. The ERLs that were obtained are summarised in the table below.

Table 8. MPCs, NCs, MAC_{eco}, and SRC_{eco} (in µg.L^{-1}) derived for dimethoate.

Substance	**MPC** [1] **eco, water**	**MPC** [1] **dw, water**	**MPC** [1] **sp, water**	**MPC** [1] **hh food, water**	**MPC** [2] **eco, marine**	**NC** [3] **water**	**NC** [3] **marine**	**MAC** eco, water	**SRC** eco, water
Dimethoate	0.07	0.1	n.d.[4]	n.d.[4]	0.007	7.0×10^{-4}	7.0×10^{-5}	0.7	3.5×10^{3}

[1] See Section 2.4.1. The derivation of the final MPC_{water} is based on direct exposure ($MPC_{eco,\ water}$), secondary poisoning ($MPC_{sp,\ water}$), and human exposure due to the consumption of fish ($MPC_{hh\ food,\ water}$). The $MPC_{dw,\ water}$ is reported separately. Since secondary poisoning and human exposure via fish are not relevant for dimethoate, the lowest value of the routes included are the values for direct aquatic toxicity ($MPC_{eco,\ water}$ and $MPC_{eco,\ marine}$).
[2] In the initial document for the meeting of the expertgroup 'qualitätsziele' (EG-Squa) of the International Commision for the Protection of the Rhine (ICPR) in March 2007, the value of 0.07 µg.L^{-1} was proposed for the $MPC_{eco,\ marine}$. However, in finalising this report an additional factor of 10 for the marine environment was considered necessary, based on the FHI guidance.
[3] For the calculation of NC_{water} the lowest MPC_{water} has been used.
[4] n.d. = not derived

Acknowledgements

Thanks are due to Dr. T. Crommentuijn, who was contact person at the Ministry of Housing, Spatial Planning and the Environment (VROM-DGM/BWL) and to Dr. M.P.M. Janssen who is program coordinator for the derivation of ERLs within the RIVM.

The results of the present report have been discussed in the scientific advisory group INS (WK-INS). The members of this group are acknowledged for their contribution.

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Appendix 1 Aquatic toxicity data selected for ERL derivation

Table A1. 1. Dimethoate: selected aquatic freshwater data for ERL derivation. Bold values are used for ERL derivation.

Chronic		Acute	
Taxonomic group	NOEC/EC10 [mg.L^{-1}]	Taxonomic group	L(E)C50 [mg.L^{-1}]
Bacteria	320	Bacteria	1731
Bacteria	574	Cyanobacteria	8.5
Cyanobacteria	100	Cyanobacteria	10
Cyanobacteria	32	Cyanobacteria	3.5[j]
Algae	20[a]	Algae	5.5
Algae	100	Algae	470
Algae	13.3[b]	Algae	16
Protozoa	1	Algae	14
Macrophyta	32	Algae	67.2[k]
Cnidaria	100	Crustacea	1.93[l]
Mollusca	10[c]	Crustacea	4.1
Crustacea	0.026[d]	Crustacea	0.19[m]
Insecta	0.32	Insecta	5.68[n]
Pisces	0.0125[e]	**Insecta**	**0.007**
Pisces	0.77[f]	Insecta	0.012
Pisces	0.32	Insecta	0.46
Pisces	0.1[g]	Insecta	0.081
Pisces	0.02[h]	Insecta	0.023
Amphibia	1[i]	Insecta	0.28
		Insecta	0.043
		Pisces	7.28[o]
		Pisces	1.39[p]
		Pisces	50
		Pisces	10.1
		Pisces	106[q]
		Pisces	45.7
		Pisces	10.2
		Pisces	5.7
		Pisces	10.3[r]
		Pisces	12.5[s]
		Pisces	108
		Pisces	0.5
		Pisces	57.1[t]
		Pisces	1.44
		Pisces	4.57
		Pisces	0.13
		Pisces	15.0[r]
		Amphibia	11.2

[a] Lowest value, parameter photosynthesis rate for *Chlamydomonas reinhardtii*
[b] Geometric mean of 30.5, 3.4, and 22.6 mg/L, parameter growth rate for *Selenastrum capricornutum*
[c] Lowest value, parameter reproduction for *Lymnaea stagnalis*
[d] Lowest value, geometric mean of 0.029 and 0.024 mg/L, parameter growth for *Daphnia magna*
[e] Lowest value, parameter mortality for *Brachydanio rerio*
[f] Geometric mean of 0.4 and 1.5 mg/L, parameter growth for *Oncorhynchus mykiss*
[g] Lowest value, parameter behaviour for *Poecilia reticulata*
[h] Lowest value, parameter mortality for *Salmo trutta*
[I] Lowest value, parameters mortality for *Xenopus laevis*
[j] Lowest value, parameter oxygen production for *Synechocystis sp.*

[k] Lowest value, geometric mean of 36, 90.4 and 93.2 mg/L, parameter biomass growth for *Selenastrum capricornutum*
[l] Geometric mean of 2.5, 6.75, 2.9, 6.4, 4.7, 22.12, 5.44, 3.5, 0.16, 0.58, 1.5, 0.74, 0.56, 1.8, 0.78, 0.8, 0.88, 3.32, 3.12, 2.2, 2, 0.465 and 4.7 mg/L, parameter mortality/immobility for *Daphnia magna*
[m] Geometric mean of 0.18 and 0.20 mg/L, parameter mortalitity for *Gammarus lacustris*
[n] Geometric mean of 5.04 and 6.41 mg/L, parameter mortalitity for *Aedes aegypti*
[o] Geometric mean of 6.8 and 7.8 mg/L, parameter mortality for *Brachydanio rerio*
[p] Geometric mean of 1.34, 1.32, 1.31 and 1.62 mg/L, parameter mortality for *Channa gachua*
[q] Geometric mean of 22.39 and 505 mg/L, parameter mortality for *Cyprinus carpio*
[r] Geometric mean of 6 andn 17.6 mg/L, parameter mortality for *Lepomis macrochirus*
[s] Geometric mean of 30, 10, 8.6, 6.2, 8.6, 23, 7.5, and 24.5 mg/L, parameter mortality for *Oncorhynchus mykiss*
[t] Geometric mean of 560, 120, 340, 13, 10.4 and 11.2 mg/L, parameter mortality for *Poecilia reticulata*
[u] Geometric mean of 23.77, 11.4 and 12.52 mg/L, parameter mortality for *Tilapia mossambica*
[v] Geometric mean of 11.7 and 10.8 mg/L, parameter mortality for *Rana cyanophlyctis*

Table A1. 2. Dimethoate: selected marine data for ERL derivation.

Chronic		Acute	
Taxonomic group	NOEC/EC10 [mg.L^{-1}]	Taxonomic group	L(E)C50 [mg.L^{-1}]
		Crustacea	15
		Crustacea	15.7[a]
		Crustacea	0.55
		Crustacea	0.45[b]
		Insecta	0.031[a]
		Pisces	117

[a] Lowest value at salinity of 38‰.
[b] Geometric mean of 0.543 and 0.366 mg/L, parameter mortality for *Neomysis integer*

Appendix 2 Information on bioconcentration of dimethoate

Table A2. 1. Bioconcentration data for dimethoate.

Species	Species properties	Substance purity [%]	Analysed	Test type	Test water	pH	Hardness or salinity [mg $CaCO_3.L^{-1}$] or [‰]	Tempe-rature [°C]	Exposure time [d]	Exp. conc. [$mg.L^{-1}$]	BCF [$L.kg_{w.w}^{-1}$]	BCF type	Ri[a]	Notes	Reference
Mollusca															
Mytilus galloprovincialis	6.95 g	93-99	Y	S	nw	7.1-7.9	38 (sal)	18	96h	3.2	0.3	Equi	2	1,2	Serrano *et al.*, 1995
Venus gallina	1.31 g	93-99	Y	S	nw	7.1-7.9	38 (sal)	18	96h	5.6	0.39	Equi	2	1,3	Serrano *et al.*, 1995
Pisces															
Clarias batrachus	35g; 20 cm	Tg		R	dtw				32d	16.66	0.23 (liver); 0.07 (muscle)	Equi	2	4,5,6	Begum *et al.*, 1994
Clarias batrachus	38g; 20 cm	94	N	R					8d	16.66	0.1 (branchial tissue)	Equi	2	4,5,7	Begum *et al.*, 1997
Poecilia reticulata	3-4 wks	98	Y	R	am		209 (hh)	23	8d	0.1	<1	Equi	1	8	Canton *et al.*, 1980

a Reliability index, according to Klimisch *et al.*, 1997

Notes:
1 Measured concentrations were within 10% of nomnal values
2 BCF at other exposure concentration was lower; BCF at 56 mg/L was 0.04.
3 BCF at other exposure concentration was lower; BCF at 32 mg/L was 0.10.
4 Fish were not fed during the experiment
5 >35 g Fish/L
6 Maximum BCF (after 48 hours of exposure): 0.8 L/kg
7 Maximum BCF (after 48 hours of exposure): 2.5 L/kg (liver) and 0.5 L/kg (muscle)
8 Fish concentrations stayed below detection limits (0.1 $mg.kg^{-1}$ fish) at al times.

Appendix 3 Information on aquatic toxicity

Table A3. 1. Acute toxicity of dimethoate to freshwater organisms. Bold values are used for ERL derivation.

Species	Species properties	A	Test type	Purity	Test water	pH	T	Hardness	Exp. time	Criterion	Test endpoint	Value	Ri [a]	Notes	Reference
				[%]			[°C]	[mg $CaCO_3.L^{-1}$]				[$mg.L^{-1}$]			
Bacteria															
Pseudomonas putida		Y		88.2			21		18h	EC50		1731	2	1	IUCLID, 2000: BASF AG, Ludwigshafen
Cyanobacteria															
Anabaena doliolum	exponentially growing	N	S	?	am		27		12d	LC50	survival	20	3	2,3	Mohapatra, 1992
Microcystis aeruginosa		N	S	20	am				6d	EC50	growth rate	8.5	2	3,4	Kallqvist and Romstad, 1994
Synechococcus leopoliensis		N	S	20	am				5d	EC50	growth rate	10	2	3,4	Kallqvist and Romstad, 1994
Synechocystis		N	S	99	am		20		1h	EC50	14C fixation	46.24	2	5	Mohapatra *et al.*, 1997
Synechocystis		N	S	99	am		20		1h	EC50	O2 production	3.5	2	5	Mohapatra *et al.*, 1997
Synechocystis sp. PCC 6803	Mid log phase	N	s	99	am				1h	LOEC	fluorescense	22.93	3	6	Mohapatra and Schiewer, 1998
Algae															
Chlamydomonas noctigama		N	S	20	am				3d	EC50	growth rate	5.5	2	4,7	Kallqvist and Romstad, 1994
Chlorella pyrenoidosa	log phase	Y	S	98	am		23	100	72h	EC50	growth reduction	470	1	8,9	Canton *et al.*, 1980
Cryptomonas pyrinoidifera		N	S	20	am				6d	EC50	growth rate	16	2	4,7	Kallqvist and Romstad, 1994
Cyclotella sp.		N	S	20	am				6d	EC50	growth rate	14	2	4,7	Kallqvist and Romstad, 1994
Selenastrum capricornutum		Y		97					72h	EC50	growth rate	282.3	1	10	Jansma *et al.*, 1991
Selenastrum capricornutum				Rogor	am		22		96h	EC50	biomass growth	36	2	4, 11	Abdel-Hamid, 1996
Selenastrum capricornutum		N	S	20	am				3d	EC50	growth rate	35	2	4,7	Kallqvist and Romstad, 1994
Selenastrum capricornutum		N	S	20	am				3d	EC50	growth rate	14	2	4,12	Kallqvist and Romstad, 1994
Selenastrum capricornutum	growth phase	Y	S	97					3d	EC50	biomass	90.4	2	10, 13, 14	Caley, unpublished data in European Commission, 2003
Selenastrum capricornutum	growth phase	Y	S	97					3d	EC50	growth	282.3	2	10, 13, 14	Caley, unpublished data in European Commission, 2003
Selenastrum capricornutum	growth phase	Y	S	39					3d	EC50	biomass	93.2	2	10, 14, 15	Caley, unpublished data in European Commission, 2003
Selenastrum capricornutum	growth phase	Y	S	39					3d	EC50	growth	190.6	2	10, 14, 15	Caley, unpublished data in European Commission, 2003
Protozoa															
Paramecium aurelia		Y	S	Tg?	am		20		90 min	NOEC	mortality/ viability	>5	2	16	Joshi and Misra, 1986
Fungi															
Saccharomyces cerevisiae		N	S	'mindestens chemisch rein'	am	3.2	28		16-18h	EC20	CO2 production; 'garleistung' (yeast performance)	500	3	17	Weber *et al.*, 2000
Mollusca															
Bellamya	adult; 20.5 mm	N	R	Rogor					96h	LC50	mortality	0.25-0.3	4	2, 18	Panigrahi, 1998

Species	Species properties	A	Test type	Purity	Test water	pH	T	Hardness	Exp. time	Criterion	Test endpoint	Value	Ri [a]	Notes	Reference
				[%]			[°C]	[mg $CaCO_3.L^{-1}$]				[$mg.L^{-1}$]			
bengalensis															
Lymnaea acuminata	adult; 20.8 mm	N	R	Rogor					96h	LC50	mortality	0.2	4	2, 18	Panigrahi, 1998
Lymnaea luteola	adult; 12.7 mm	N	R	Rogor					96h	LC50	mortality	0.15-0.2	4	2, 18	Panigrahi, 1998
Indoplanorbis exustus	adult; 13.3 mm	N	R	Rogor					96h	LC50	mortality	0.15	4	2, 18	Panigrahi, 1998
Physa fontinalis			F	Rogor	nw	6.3	15	11	96h	LC50	mortality	>2	2	4, 19	Baekken and Aanes, 1991
Crustacea															
Asellus aquaticus		N	S			7.1	18	160	48h	LC50	mortality	3	4	2, 18, 20	Thybaud *et al.*, 1987
Daphnia magna	<24h	N	S		am	7.9	19	202	26h	LC50	mortality	2.5	2	21	Frear and Boyd, 1967
Daphnia magna	<72h	N	S	ag		7-7.8	22		24h	EC50	immobility	3.5-10	2	20, 22	Devillers *et al.*, 1985
Daphnia magna	<24h	Y	S	98	am: DSW	8.2	19	210	48	EC50	immobility and paralysis	2.9	1	8, 9, 23	Canton *et al.*, 1980
Daphnia magna	<24h	Y	S	98	am: DSW	8.2	19	210	48	LC50	mortality	6.4	1	8, 9, 23	Canton *et al.*, 1980; Hermens *et al.*, 1984
Daphnia magna		N	S	95	-	-	20		24	EC50	immobility	4.7	2	9, 24	Jansma *et al.*, 1991: ref 14
Daphnia magna		N	S						24	EC50	immobility	22.12	2	24	IUCLID, 2000: BASF Ludwigshafen
Daphnia magna		N	S						48	EC50	immobility	5.44	2	24	IUCLID, 2000: BASF Ludwigshafen
Daphnia magna		N		94					96h	EC50	mortality	3.5	2	25	IUCLID, 2000: BASF Ludwigshafen
Daphnia magna	<24h	N	S	Tg		7.5	20	200	24	EC50	immobility	0.16	2	9, 24, 26	Vighi *et al.*, 1991
Daphnia magna	<48h								24h	LC50	immobility	0.02	4	27	Hessen *et al.*, 1994
Daphnia magna				99	am				48h	LC50	mortality	0.58	2	23	Maas, 1982
Daphnia magna	<24h	Y	S	>99	am: DSW	8.2-8.4	20	223	48h	EC50	immobility	1.5	1	4, 28, 29	Beusen and Neven, 1989
Daphnia magna	<24h	Y	S	10	am: DSW	8.2-8.4	20	223	48h	EC50	immobility	0.74	1	4, 28, 29	Beusen and Neven, 1989
Daphnia magna	<24h	Y	S	10	am: DSW	8.2-8.4	20	223	48h	EC50	immobility	0.56	1	4, 28, 29	Beusen and Neven, 1989
Daphnia magna	<24h	Y	Sc	>99	am: DSW	8.2-8.4	20	223	48h	EC50	immobility	1.8	1	4, 28, 29	Beusen and Neven, 1989
Daphnia magna	<24h	Y	Sc	10	am: DSW	8.2-8.4	20	223	48h	EC50	immobility	0.78	1	4, 28, 29	Beusen and Neven, 1989
Daphnia magna	<24h	Y	Sc	10	am: DSW	8.2-8.4	20	223	48h	EC50	immobility	0.8	1	4, 28, 29	Beusen and Neven, 1989
Daphnia magna	<24h	Y	Sc	10	DSW	8.4	20	223	48h	EC50	immobility	0.88	1	29	Beusen and Neven, 1989
Daphnia magna	<24h	N	S	>95	am		27		48h	LC50	mortality	3.32	2	30	Song *et al.*, 1997
Daphnia magna	<24h	N	S	>95	am		20		48h	LC50	mortality	3.12	2	30	Song *et al.*, 1997
Daphnia magna		Y	S	38.9					48h	LC50	immobility	2.2	2	24, 31, 32	Caley, unpublished data in European Commission, 2003
Daphnia magna		Y	S	99.1					48h	LC50	immobility	2	2	24, 32, 33	Hertl, unpublished data in European Commission, 2003
Daphnia magna	juveniles, 2.35g; 62mm	Y	R	99					96h	LC50	immobility	0.465	2	24, 34	Wuthrich, unpublished data in European Commission, 2003
Daphnia magna									96h	LC50	mortality	3.32	4	35	US-EPA, 2006
Daphnia magna		N	S	95					48h	LC50	immobility	4.7	2	24	Ellgehause, unpublished data in European Commission, 2003
Echinogammarus tibaldii	mature	N	S	99	rw	7.9	8	240	96h	LC50	immobility	4.1	2	30	Pantani *et al.*, 1997

Species	Species properties	A	Test type	Purity	Test water	pH	T	Hardness	Exp. time	Criterion	Test endpoint	Value	Ri [a]	Notes	Reference
				[%]			[°C]	[mg $CaCO_3.L^{-1}$]				[$mg.L^{-1}$]			
Gammarus lacustris		N	S		rw	7.1	21	47	96h	LC50	mortality	0.2	4	36	Sanders, 1969
Gammarus lacustris	mature		S	97.4	rw	7.1	21	44	96h	LC50	mortality	0.2	2		Mayer and Ellersieck, 1986
Gammarus lacustris			F	Rogor	nw	6.3	15	11	96h	LC50	mortality	0.18	2	4	Baekken and Aanes, 1991
Machrobrachium lamerri									96h	LC50	mortality	2.6	4		Murgatroyd and Patel, 1994, in Roast *et al.*, 1999
Insecta															
Aedes aegypti	4th instar, field strain	N	S	Cf					24h	LC50	mortality	2.4	4	2, 18, 37	Mohiuddin *et al.*, 1991
Aedes aegypti	4th instar, lab-reared	N	S	Cf					24h	LC50	mortality	1.1	4	2, 18, 37	Mohiuddin *et al.*, 1991
Aedes aegypti	4th instar, lab-reared	N	S						24h	LC50	mortality	4.6	4	2, 18, 38	Schmidt and Weidhaas, 1961
Aedes aegypti	1st instar	N	S	>95	am		27		48h	LC50	mortality	5.04	2	30	Song *et al.*, 1997
Aedes aegypti	1st instar	N	S	>95	am		20		48h	LC50	mortality	6.41	2	30	Song *et al.*, 1997
Anopheles quadrimaculatus									24h	LC50	mortality	4	4		Schmidt and Weidhaas, 1958, in: Schmidt and Weidhaas, 1961
Baetis rhodani	last instar		F	Rogor	nw	6.3	15	11	96h	**LC50**	**mortality**	**0.007**	2	4	Baekken and Aanes, 1991
Chironomid	larvae	N	S	30	dtw	7.7-7.8	28	93-96	24h	LC50	mortality	0.012	2	39	Joshi *et al.*, 1975
Culex fatigans	4th instar	N	S	tg	tw		28-31		24h	LC50	mortality	0.46	2	40	Tabassum *et al.*, 1993
Heptagenia sulfurea	last instar		F	Rogor	nw	6.3	15	11	96h	LC50	mortality	0.081	2	4	Baekken and Aanes, 1991
Hydropsyche siltalai	last instar		F	Rogor	nw	6.3	15	11	96h	LC50	mortality	0.023	2	4	Baekken and Aanes, 1991
Libellula sp.	naiads; 2 cm	N	S	30	nw	8	30	167	96h	LC50	mortality	0.28	2	4	Sateesh *et al.*, 1996
Pteronarcys californica	naiads: 30-35mm	N	S	tg	rw	7.1	15.5	47	96h	LC50	mortality	0.043	4	36	Sanders and Cope, 1968
Pteronarcys californica	nymph						16		96h	LC50	mortality	0.043	4	36	Cope, 1965
Pteronarcys californica									48h	LC50	mortality	0.043	4	36	US-EPA, 2006
Pteronarcys californica	2nd year class		S	97.4	rw	7.1	21	44	96h	LC50	mortality	0.043	2		Mayer and Ellersieck, 1986
Pisces															
Brachydanio rerio	mature	N	S	Ag		7.8-8	24		24h	LC50	mortality	>10	2	20, 22, 30	Devillers *et al.*, 1985
Brachydanio rerio		Y	S	10	am: DSW	7.4-8.4	23	223	96h	LC50	mortality	6.8	1	4, 28, 29	Beusen and Neven, 1989
Brachydanio rerio		Y	S	10	am: DSW	7.4-8.4	23	223	96h	LC50	mortality	7.8	1	4, 28, 29	Beusen and Neven, 1989
Brachydanio rerio	embryos	N		99	dw				72h	LC50	mortality	259	4	41	Roales and Perlmutter, 1974
Catla catla	fingerlings; 30 mm	N	S	30		7.2	27	60-70	96h	LC50	mortality	10.5	2	21, 41	Kulshrestha *et al.*, 1986
Channa gachua	116 mm; 18g	N	R	30	nw	7.2	24	60	96h	LC50	mortality	1.343	2	41, 42	Verma *et al.*, 1978
Channa gachua	116 mm; 18g	N	R	30	nw	7.2	24	60	96h	LC50	mortality	1.32	2	41, 43	Verma *et al.*, 1978
Channa gachua	116 mm; 18g	N	R	30	nw	7.2	24	60	96h	LC50	mortality	1.313	2	41, 44	Verma *et al.*, 1978
Channa gachua	116 mm; 18g	N	R	30	nw	7.2	24	60	96h	LC50	mortality	1.62	2	41, 45	Verma *et al.*, 1978
Channa punctatus	15 cm; 60g	N	S		nw	7.2	25-27	160	96h	LC50	immobilisation	20.5	3	2, 30, 46	Anees, 1975
Chingatta									96h	LC50	mortality	4.48	4	47	Verma *et al.*, 1978
Cirrhina mrigala	145-195mm;		35%							LC50	mortality	3.138	4	48, 49	Verma *et al.*, 1979

Species	Species properties	A	Test type	Purity	Test water	pH	T	Hardness	Exp. time	Criterion	Test endpoint	Value	Ri [a]	Notes	Reference
				[%]			[°C]	[mg $CaCO_3.L^{-1}$]				[$mg.L^{-1}$]			
Clarias batrachus	88-109g 38g; 20cm	N	R	94	dtw				96h	LC50	mortality	50	2		Begum *et al.*, 1994
Clarias batrachus	35g	N	S	30		7.3-7.5	27-29	98-100	96h	LC50	mortality	65	3	21, 50	Begum and Vijayaraghavan, 1995b
Cirrhinus mrigala	fingerlings; 30 mm	N	S	30		7.2	27	60-70	96h	LC50	mortality	10.1	2	21	Kulshrestha *et al.*, 1986
Cyprinus carpio		Y	S	Tg					96	LC50	mortality	505	1	51, 52	Jansma *et al.*, 1991: ref 13
Cyprinus carpio		Y	S		rw		21		96h	NOEC		694	4	51, 52, 53	IUCLID, 2000: BASF AG Ludwigshafen
Cyprinus carpio	fingerlings; 5 cm; 1.3 g	N	S			normal			72h	LC50	mortality	3.56	3	4, 54	Dutt and Guha, 1988
Cyprinus carpio	from pesticide-free hatchery	N	S	30	dtw	7	20-24		7d	LC50	mortality	22.39	2	4	Basak and Konar, 1978
Cyprinus carpio		Y	S	Tg					96h	LC50	mortality	694	4	9, 51, 55, 56	Bathe, unpublished data inEuropean Commission, 2003
Heteropneustes fossilis	from pesticide-free hatchery	N	S	30	dtw	7	20-24		7d	LC50	mortality	45.71	2	4	Basak and Konar, 1978
Heteropneustes fossilis									96h	LC50	mortality	24	4	51, 57	Dubale and Awasthi, 1980, in Dubale and Awasthi, 1982
Labeo rohita	fingerlings; 30 mm	N	S	30		7.2	27	60-70	96h	LC50	mortality	10.2	2	21	Kulshrestha *et al.*, 1986
Lebistes reticulatus	3.75 cm; 2.7 g	N	R	cg; 30	nw?	7.9	26	228	96h	LC50	mortality	5.7	2	30, 58	Gupta *et al.*, 1984
Lepomis macrochirus	0.33g			tg			24		96h	LC50	mortality	6	4	36	Cope, 1965
Lepomis macrochirus	0.3g		S	97.4	rw	7.1	24	44	96h	LC50	mortality	6	2		Mayer and Ellersieck, 1986
Lepomis macrochirus									24h	LC50	mortality	28	4		Edwards, 1977
Lepomis macrochirus		Y	R	38.9					96h	LC50	mortality	17.6	2	59	Caley et al, unpublished data in European Commission, 2003
Oncorhynchus mykiss	1.5g			tg			13		96h	LC50	mortality	8.5	4	36	Cope, 1963
Oncorhynchus mykiss		Y	S	Tg					96	LC50	mor/immo	30	1	8, 9, 51	Jansma *et al.*, 1991
Oncorhynchus mykiss	6 mo	N	S	98	tw		12	98	48h	LC50	mortality	10	2	8, 9	Canton *et al.*, 1980
Oncorhynchus mykiss	6 mo	N	S	98	tw		12	98	48h	EC50	mortality and paralysis and abnormal behaviour	8.6	2	8, 9	Canton *et al.*, 1980
Oncorhynchus mykiss	1.5g		S	97.4	rw	7.1	13	44	96h	LC50	mortality	6.2	2		Mayer and Ellersieck, 1986
Oncorhynchus mykiss	1.5g		S	97.4	rw	7.4	13	272	96h	LC50	mortality	8.6	2		Mayer and Ellersieck, 1986
Oncorhynchus mykiss	5-7g	N	R		-	-	15		96	LC50	mor/immo	5	4	60	Jansma *et al.*, 1991: ref 38
Oncorhynchus mykiss		N	S	Tg			16		96	LC50	mortality	30.2	4	51, 53	IUCLID, 2000: BASF AG Ludwigshafen
Oncorhynchus mykiss		N	S	95					24h	LC50	mortality	23	2	61	IUCLID, 2000: BASF AG Ludwigshafen
Oncorhynchus mykiss		N	S	Tg					96	LC50	mortality	7.5	2	61	IUCLID, 2000: BASF AG Ludwigshafen

Species	Species properties	A	Test type	Purity	Test water	pH	T	Hardness	Exp. time	Criterion	Test endpoint	Value	Ri [a]	Notes	Reference
				[%]			[°C]	[mg $CaCO_3.L^{-1}$]				[$mg.L^{-1}$]			
Oncorhynchus mykiss									24h	LC50	mortality	20	4		Edwards, 1977
Oncorhynchus mykiss		Y	S	Tg					96h	LC50	mortality	30.2	4	9, 51, 53, 62	Bathe, unpublished data in European Commission, 2003 Caley et al, unpublished data in European Commission, 2003
Oncorhynchus mykiss		Y	R	38.9					96h	LC50	mortality	24.5	2	59, 63	
Oncorhynchus mykiss									96h	LC50	mortality	6.2	4	36	US-EPA, 2006
Oryzias latipes	4-5 wks	Y	S	98	am: DSW	8.2	23	210	96	EC50	mortality and paralysis	108	1	8, 9	Jansma *et al.*, 1991
Phoxinus phoxinus	0.74g	N	R	20?	nw	6.3	10	11	96h	LC50	mortality	0.5	2	21	Grande *et al.*, 1994
Poecilia reticulata	3-4 wks	Y	R	98	am: DSW	8.2	23	210	96	LC50	mortality mortality and paralysis and abnormal	560	1	8, 9, 64	Canton *et al.*, 1980
Poecilia reticulata	3-4 wks	Y	R	98	am: DSW	8.2	23	210	96	EC50	behaviour	120	1	8, 9, 64	Canton *et al.*, 1980
Poecilia reticulata				99	am				96h	LC50	mortality	340	2	64, 65	Maas, 1982
Poecilia reticulata		Y	S	10	am: DSW	7.4-8.4	23	223	96h	LC50	mortality	13	1	4, 8, 66	Beusen and Neven, 1989
Poecilia reticulata		Y	S	10	am: DSW	7.4-8.4	23	223	96h	LC50	mortality	10.4	1	4, 8, 66	Beusen and Neven, 1989
Poecilia reticulata		Y	S	10	am: DSW	7.4-8.4	23	223	96h	LC50	mortality	11.2	1	4, 8, 66	Beusen and Neven, 1989
Poecilia reticulata	2.4 cm; 0.28g	N		30			23			LC50	mortality	4.64	4	57	Ramana *et al.*, 1992
Procambarus clarki	4-10g	N	S	Cg	tw	7.6	16-32		72h	LC50	mortality	>20	3	2, 41, 67	Muncy and Oliver, 1963
Puntius conchonius	>2 yr; 5.66 cm	N		30		7.46	12.8	402	96h	LC50	mortality	1.435	2	49, 68	Pant and Singh, 1983
Rutilus rutilus	0.42g	N	R	20?	nw	6.3	10	11	96h	LC50	mortality	0.5	2	21	Grande *et al.*, 1994
Saccobranchus fossils	50-75 mm; 5-10 g	N	S	30		7.2	18		96h	LC50	mortality	4.57	2	4, 30, 49	Verma *et al.*, 1982
Salmo salar	1.1g	N	R	20?	nw	6.3	10	11	96h	LC50	mortality	0.13	2	21	Grande *et al.*, 1994
Salmo trutta	1.9g	N	R	20?	nw	6.3	10	11	96h	LC50	mortality	0.13	2	21	Grande *et al.*, 1994
Salvelinus alpinus	2.1g	N	R	20?	nw	6.3	10	11	96h	LC50	mortality	0.13	2	21	Grande *et al.*, 1994
Salvelinus namaycush	1.8g	N	R	20?	nw	6.3	10	11	96h	LC50	mortality	0.13	2	21	Grande *et al.*, 1994
Tilapia mossambica	fingerlings; 5 cm; 1.4 g	N	S			normal			72h	LC50	mortality	4.98	3	4, 54	Dutt and Guha, 1988
Tilapia mossambica	from pesticide-free hatchery	N	S	30	dtw	7	20-24		7d	LC50	mortality	23.77	2	4	Basak and Konar, 1978
Tilapia mossambica	fry; 1-1.5 cm	N	S	40?	tw				48h	LC50	mortality	11.4	2	69	Shafiei and Costa, 1990
Tilapia mossambica	fingerlings; 2.5-4.5 cm	N	S	40?	tw				48h	LC50	mortality mortality mortality	12.52	2	70	Shafiei and Costa, 1990
Amphibia															
Rana hexadactyla	tadpole, 20mm; 500 mg	N	R	cg; 30?		6.2	14	20	96h	LC50	mortality	0.00782	3	21, 30, 71	Khangarot *et al.*, 1985
Rana cyanophlyctis	male; 10g	N	R	30	tw	7.3-7.8	23	60-70	96h	LC50	mortality	11.7	2/4	72	Mudgall and Patil, 1987
Rana	female; 18g	N	R	30	tw	7.3-	23	60-70	96h	LC50	mortality	10.8	2/4	73	Mudgall and Patil, 1987

Species	Species properties	A	Test type	Purity	Test water	pH	T	Hardness	Exp. time	Criterion	Test endpoint	Value	Ri [a]	Notes	Reference
				[%]			[°C]	[mg $CaCO_3.L^{-1}$]				[$mg.L^{-1}$]			
cyanophlyctis						7.8									

a Reliability index, according to Klimisch *et al.*, 1997

Notes:
1 According to DIN 38412
2 Purity unknown
3 Survival counted on agar plates
4 Results reported in mg/L active ingredient
5 Results calculated from reported data using graphpad
6 Only one concentration tested
7 Using microplate technique
8 The substance was proven to be stable during the test
9 Test results based on nominal concentrations
10 According to OECD Guideline 201
11 Using microplate procedure of Blaise (1986); same LC50 value for immobilized and free cells.
12 Bottle test according to OECD guidelines
13 Measured concentrations after 72h are 22-98% of nominal concentrations
14 Results based on initial measured concentrations.
15 Measured concentrations after 72h are 40-98% of nominal concentrations
16 Both with and without sunlight (phototoxicity) no mortality at highest concentration tested. Also no mortality with 5 hours of pre-exposure before sunlight.
17 Low pH used to make yeast extra sensitive. Yeast normally does occur in surface waters.
18 Probably not corrected for a.i.
19 25% mortality at highest test concentration of 2 mg/L
20 French article
21 It is not explicitly mentioned if results are corrected for purity but probably they are. Nevertheless, if this is not the case, results in a.i. could only be lower.
22 Toxicity in classes instead of absolute values
23 According to NEN 6501
24 According to OECD guideline 202
25 According to US EPA test
26 Results reported in mol/L and recalculated into mg/L
27 Result given as 'near' 0.02 mg/L
28 >90% of the compound was still measured after 48h.
29 Following guidelines by the European Commision
30 Including solvent controls
31 Measured concentrations are 77-112% of nominal concentrations
32 Based on mean measured concentrations
33 Measured concentrations are 86-96% of nominal concentrations
34 measured concentrations within 20% of nominal concentrations
35 Study probably identical to Song and Brown
36 Study probably identical to Mayer and Ellersieck
37 According to WHO methods
38 Following standard orlande test method
39 Results reported probably not corrected for purity (original LC50 0.04 mg/L); reported here is corrected result
40 No mention of (solvent)controls
41 LC50 expressed as TLm50.
42 Results reported probably not corrected for purity (original LC50 4.475 mg/L); reported here is corrected result
43 Results reported probably not corrected for purity (original LC50 4.4 mg/L); reported here is corrected result
44 Results reported probably not corrected for purity (original LC50 4.375 mg/L); reported here is corrected result

45 Results reported probably not corrected for purity (original LC50 5.4 mg/L); reported here is corrected result
46 30 g fish/L
47 Purity may be 30%
48 Very little information given on test conditions and setup
49 According to APHA standard methods
50 35-40 g fish/L
51 according to BBA33
52 LC50 based on measured concentrations which were generally 61-74% of nominal concentrations.
53 Probably the same study as described in Jansma et al.
54 Badly described (and performed?) study
55 Measured concentrations 58-97% of nominal concentrations
56 May be the same study as described in Jansma et al?
57 Result from another study
58 Results reported probably not corrected for purity (original LC50 19 mg/L); reported here is corrected result
59 According to OECD Guideline 203
60 Only an imcomplete test description was available
61 According to EPA static jar test 1069, method TSD 1206
62 Measured concentrations 55 - 137% of nominal concentrations
63 Measured concentrations 123-133% of nominal concentrations; According to OECD Guideline 203
64 According to NEN 6504
65 LC50 determined through graphical interpolation on log-probitpaper
66 Following guidelines by the European Commision
67 Containers lined with plastic bags
68 Results reported probably not corrected for purity (original LC50 4.784 mg/L); reported here is corrected result
69 Results reported probably not corrected for purity (original LC50 28.5 mg/L); reported here is corrected result
70 Results reported probably not corrected for purity (original LC50 31.3 mg/L); reported here is corrected result
71 results reported as ppb, but probably ppm.
72 Results reported probably not corrected for purity (original LC50 39 mg/L); reported here is corrected result
73 Results reported probably not corrected for purity (original LC50 36 mg/L); reported here is corrected result

Table A3. 2. Acute toxicity of dimethoate to marine organisms. Bold values are used for ERL derivation.

Species	Species properties	A	Test type	Purity [%]	Test water	pH	T [°C]	Salinity [‰]	Exp. time	Criterion	Test endpoint	Value [mg.L^{-1}]	Ri[a]	Notes	Reference
Macrophyta															
Chaetomorpha linum		N	S	96	nw (filtered)	7.8	30	31	6h	ECx: EC03	photosynthesis	0.05	3	1, 2, 3	Ramachandran *et al.*, 1984
Enteromorpha intestinalis		N	S	96	nw (filtered)	7.8	30	31	6h	ECx: EC08	photosynthesis	0.05	3	1, 2, 3	Ramachandran *et al.*, 1984
Gracilaria verrucosa		N	S	96	nw (filtered)	7.8	30	31	6h	ECx: EC12	photosynthesis	0.05	3	1, 2, 3	Ramachandran *et al.*, 1984
Gratiloupia doryphora		N	S	96	nw (filtered)	7.8	30	31	6h	ECx: EC18	photosynthesis	0.05	3	1, 2, 3	Ramachandran *et al.*, 1984
Halphila ovalis		N	S	96	nw (filtered)	7.8	30	31	6h	ECx: EC14	photosynthesis	0.05	3	1, 2, 3	Ramachandran *et al.*, 1984
Halodule uninervis		N	S	96	nw (filtered)	7.8	30	31	6h	ECx: EC24	photosynthesis	0.05	3	1, 2, 3	Ramachandran *et al.*, 1984
Mollusca															
Cardium edule			S		nw		15		48h	LC50	mortality	>3.3	2	4, 5	Portmann and Wilson, 1971
Mytilus galloprovincialis	6.95 g	Y	S	93-99	nw	7.1-7.9	18	38	96h	LC50	mortality	>56	1	5, 6, 7, 8	Serrano *et al.*, 1995
Oyster	juvenile	N	F		nw		20	31	48h	EC50	50% decrease in shell growth	>1	4	9	Butler, 1964
Venus gallina	1.31g	Y	S	93-99	nw	7.1-7.9	18	38	96h	NOEC	mortality	>32	1	5, 6, 7, 8	Serrano *et al.*, 1995
Rotifera															
Brachionus plicatilis	2d old	Y	S	>95	rw		25	26	24h	EC50	immobility	244	4	10, 11	Guzzella *et al.*, 1997
Crustacea															
Americamysis bahia									96h	LC50	mortality	15	2		US-EPA, 2006
Artemia sp.	4rh naupliar stage	N	S	>95	am	8	27	38	48h	LC50	mortality	15.73	2	5	Song and Brown, 1998; Song *et al.*, 1997
Artemia sp.	4rh naupliar stage	N	S	>95	am	8	27	9.5	48h	LC50	mortality	10.14	2	5	Song and Brown, 1998
Artemia sp.	28h old	Y	S	>95	rw		25	26	24h	EC50	immobility	303	4	10, 11	Guzzella *et al.*, 1997
Carcinus maenas			S		nw		15		48h	LC50	mortality	>3.3	2	4, 5	Portmann and Wilson, 1971
Crangon crangon			S		nw		15		48h	LC50	mortality	0.3-1	2	4, 5	Portmann and Wilson, 1971
Crangon crangon									96h	LC50	mortality	0.3-1	4	12	Murgatroyd and Patel, 1994, in Roast *et al.*, 1999
Metapenaeus monoceros	75 mm; 2.5g	N	R	30	nw	7.1	23	15	96h	LC50	mortality	2.86	4	13, 14	Reddy and Rao, 1992
Neomysis integer	adult, 15mm	N	R	40	nw		12	7	96h	LC50	immobility	0.543	2	15	Roast *et al.*, 1999
Neomysis integer	adult, 15mm	N	R	40	nw		12	7	96h	LC50	immobility	0.366	2	15	Roast *et al.*, 1999
Pandalus montagui			S		nw		15		48h	LC50	mortality	>0.033	2	4, 5	Portmann and Wilson, 1971
Penaeus aztecus		N	F		nw		22	30	48h	EC50	mortality or loss of equilibrium	>1	4	9, 16	Butler, 1964
Penaeus aztecus	juvenile	N	F	99.3			22	30	48h	EC50		>1	2		Mayer, 1986
Penaeus monodon	50d old; postlarvae	N	R	Perfekt hion					96h	EC100	behaviour	1	4	13, 17	Vogt, 1987. Aquaculture 67: 157-164

Species	Species properties	A	Test type	Purity [%]	Test water	pH	T [°C]	Salinity [‰]	Exp. time	Criterion	Test endpoint	Value [mg.L^{-1}]	Ri[a]	Notes	Reference
Penaeus monodon	50d old; postlarvae	N	R	Perfekt hion					15h	LC100	mortality	10	4	13, 18	Vogt, 1987. Aquaculture 67: 157-164
Insecta															
Aedes taeniorhynchus	1st instar	N	S	>95	am	8	27	38	48h	LC50	mortality	0.031	2	5	Song and Brown, 1998; Song *et al.*, 1997
Aedes taeniorhynchus	1st instar	N	S	>95	am	8	27	12.7	48h	LC50	mortality	0.2	2	5	Song and Brown, 1998; Song *et al.*, 1997
Pisces															
Aphanius fasciatus	immature; >20mm	N	S	40	nw		19-20	37-38	96h	LC50	mortality	117	2	19, 20	Boumaiza *et al.*, 1979
Fundulus similis	juvenile	N	F		nw		20	32	48h	EC50	mortality	>1	4	9	Butler, 1964
Fundulus similis	juvenile	N	F	99.3			20	32	48h	LC50	mortality	>1	2		Mayer, 1986

a Reliability index, according to Klimisch *et al.*, 1997

Notes:

1 Only concentration tested. (0.05 mg/L); phostosynthesis and respiration measured using light/dark bottle method. Three replicates; max. 5% difference between replicates; not sure if measured effect is statistically significant.
2 Using light/dark bottle method
3 Not reported if measured effect is statistically significant.
4 Methods reported in Portmann, 1968 and Portmann and Connor, 1968.
5 Including solvent controls
6 No mortality at highest concentration tested
7 Measured concentrations differed <10% from nominal concentrations
8 Results based on nominal concentrations
9 Badly described (and performed?) study
10 Test conducted using toxkits
11 Result may have been a 1000 times lower because other compounds in the study appear to have been tested far beyond their solubility limits
12 Very little information. Is this referring to the Portmann experiment?
13 It is not explicitly mentioned if results are corrected for purity but probably they are. Nevertheless, if this is not the case, results in a.i. could only be lower.
14 According to standard APHA methods
15 According to GLP
16 20% effect at 1.0 mg/L
17 1 mg/L is lowest concentration tested
18 100% mortality at 10 mg/L. 100% behavioural effect at 1 mg/L after 4 days, experiment terminated afterwards
19 Results reported in mg/L active ingredient
20 French article

Table A3. 3. Chronic toxicity of dimethoate to freshwater organisms.

Species	Species properties	A	Test type	Purity [%]	Test water	pH	T [°C]	Hardness [mg $CaCO_3$. L^{-1}]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Ri[a]	Notes	Reference
Bacteria															
Pseudomonas fluorescens	log phase	N	S	tech.	am	-	22	81	8h	NOEC	specific growth rate	320	2	1	Slooff and Canton, 1983
Pseudomonas putida		Y		88.2			21		18h	NOEC		574	1	2	IUCLID, 2000: BASF AG, Ludwigshafen
Cyanobacteria															
Anabaena doliolum	exp. growing axenic	N	S	?	am		27		12d	LOEC	survival	5	3	3, 4, 5	Mohapatra, 1992
Anabaena	culture	N	S	tg	am		26		72h	NOEC	growth	100	2	1, 6	Perona *et al.*, 1991
Microcystis aeruginosa	log phase	N	S	tech.	am	-	23	24	96	NOErC	specific growth rate	32	2	1	Slooff and Canton, 1983
Fungi															
Achlya racemosa					am		21		20d	EC100	sporulation, mycelium growth	5	4	3	Khallil and Omar, 1993
Dictyuchus monosporus					am		21		20d	EC100	sporulation, mycelium growth	5	4	3	Khallil and Omar, 1993
Saprolegnia ferax					am		21		20d	EC100	sporulation, mycelium growth	5	4	3	Khallil and Omar, 1993
Thraustheca clavata					am		21		20d	EC100	sporulation, mycelium growth	5	4	3	Khallil and Omar, 1993
Allomyces arbuscula					am		21		20d	EC100	sporulation, mycelium growth	5	4	3	Khallil and Omar, 1993
Algae															
Chlamydomonas reinhardtii	late log phase	N	S	40%	am	6.8	25		8d	NOEC	growth rate	>40	2	7, 8, 9	Wong and Chang, 1988
Chlamydomonas reinhardtii	late log phase	N	S	40%	am	6.8	25		8d	NOEC	photosynthetic rate	20	2	7, 8	Wong and Chang, 1988
Chlamydomonas reinhardtii	late log phase	N	S	40%	am	6.8	25		8d	LOEC	Chla content in log phase	<1	2	7, 10	Wong and Chang, 1988
Chlorella vulgaris	exponential growth phase		S	tg?	am		27		10d	NOEC	survival biomass	1	3	4, 11	Mohapatra and Mohanty, 1992
Scenedesmus pannonicus	log phase	N	S	tech.	am	-	23	54	96	NOEbC	growth	100	2	1	Slooff and Canton, 1983
Selenastrum capricornutum		Y		97%					72h	NOEC	growth rate	30.5	1	12	IUCLID, 2000: BASF AG, Ludwigshafen
Selenastrum capricornutum		N	S	20%	am				3d	EC10	growth rate	3.4	2	7, 13	Kallqvist and Romstad, 1994
Selenastrum capricornutum	growth phase	Y	S	39%					3d	NOEC	growth	30.5	4	12, 14, 15	Caley, unpublished data in European Commission, 2003
Selenastrum capricornutum	growth phase	Y	S	39%					3d	NOEC	growth	22.6	2	12, 16, 17	Caley, unpublished data in European Commission, 2003
Protozoa															
Tetrahymena pyriformis		N	S	tg?	am	7	27		96h	LOEC	cell number	1	2	18, 19, 20	Kumar *et al.*, 1989

Species	Species properties	A	Test type	Purity [%]	Test water	pH	T [°C]	Hardness [mg $CaCO_3$. L^{-1}]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Ri[a]	Notes	Reference
Colpidium campylum			S		am				43h	MAD (minimal active dose)	numbers present	>10	4	21, 22, 23	Dive *et al.*, 1980
Macrophyta															
Lemna minor		N	S	tech.	am	-	25	268	7d	NOEC	specific growth rate	32	2	1	Slooff and Canton, 1983
Cnidaria															
Hydra oligactis	budless	N	R	tech.	am	-	18	210	21d	NOEC	specific growth rate	100	2	1	Slooff and Canton, 1983
Mollusca															
Lymnaea stagnalis	5mo	N	R	tech.	am	-	20	210	40d	NOEC	reproduction	10	2	1	Slooff and Canton, 1983
Lymnaea stagnalis	5mo	N	R	tech.	am	-	20	210	40d	NOEC	mortality	32	2	1	Slooff and Canton, 1983
Lymnaea stagnalis	eggs	N	R	tech.	am	-	20	210	7d	NOEC	hatch	32	2	1	Slooff and Canton, 1983
Crustacea															
Daphnia magna	24h	Y	R	tech.	am: DSW	8.2	19	210	21d	NOEC	mortality	0.032	2	1, 24	Slooff and Canton, 1983; Canton *et al.*, 1980
Daphnia magna	24h	Y	R	tech.	am: DSW	8.2	19	210	21d	NOEC	reproduction	0.1	2	1, 25	Slooff and Canton, 1983; Canton *et al.*, 1980
Daphnia magna		N		94					28d	NOEC	mortality	0.23	2	26	IUCLID, 2000: BASF AG Ludwigshafen
Daphnia magna		N		99					21d	NOEC	immobilization	0.04	2	26, 27	IUCLID, 2000: BASF AG Ludwigshafen
Daphnia magna		N		99					21d	NOEC	reproduction	0.04	2	26, 27	IUCLID, 2000: BASF AG Ludwigshafen
Daphnia magna	<24h	N	R	unknown	am: DSW		19		16d	NOEC	growth	0.029	2	19, 20, 28, 29	Deneer *et al.*, 1988
Daphnia magna	<24h	N	R	unknown	am: DSW		19		16d	EC10	growth	0.21	2	19, 20, 29	Deneer *et al.*, 1988
Daphnia magna	<24h	Y	R	98%	am: DSW	8.2	19	210	16d	EC50	reproduction	0.31	1	30, 31	Hermens *et al.*, 1984
Daphnia magna	<24h	Y	R	>99	am: DSW	8.2-8.4	20	223	23d	NOEC	reproduction	0.1	1	7, 31, 32, 33	Beusen and Neven, 1989
Daphnia magna	<24h	Y	R	>99	am: DSW	8.2-8.4	20	223	23d	NOEC	reproduction	0.08	1	7, 31, 32, 34	Beusen and Neven, 1989
Daphnia magna	<24h	Y	R	10%	am: DSW	8.2-8.4	20	223	23d	NOEC	reproduction	0.047	1	7, 31, 32, 35	Beusen and Neven, 1989
Daphnia magna	<24h	Y	R	10%	am: DSW	8.2-8.4	20	223	23d	NOEC	reproduction	0.076	1	7, 31, 32, 36	Beusen and Neven, 1989
Daphnia magna	juveniles	Y	R	38.9					21d	NOEC	growth	0.024	2	37, 38, 39, 40	Caley et al, unpublished data in European Commission, 2003
Daphnia magna	juveniles, 2.35g; 62mm	Y	R	99					21d	NOEC	reproduction	0.04	4	15, 41, 42, 43	Wuthrich, unpublished data in European Commission, 2003
Daphnia magna										NOEC	reproduction, survival, growth	0.04	4	15, 43	US-EPA, 2006
Insecta															

Species	Species properties	A	Test type	Purity [%]	Test water	pH	T [°C]	Hardness [mg $CaCO_3$. L^{-1}]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Ri[a]	Notes	Reference
Culex pipiens	1st instar	N	R	tech.	am	-	27	210	25d	NOEC	mortality	0.32	2		Slooff and Canton, 1983
Culex pipiens	1st instar	N	R	tech.	am	-	27	210	25d	NOEC	development	0.32	2		Slooff and Canton, 1983
Pisces															
Brachydanio rerio	new eggs	N	R	20?	nw	6.3	10	11	12d	NOEC	hatching	0.2	2	20, 44	Grande *et al.*, 1994
Brachydanio rerio	new eggs	N	R	20?	nw	6.3	10	11	12d	NOEC	survival	0.0125	2	20, 44, 45	Grande *et al.*, 1994
Catla catla	fingerlings; 30 mm	N	S	30%		7.2	27	60-70	30d	NOEC		6.8-7.3	2/4	20, 46	Kulshrestha *et al.*, 1986
Channa punctatus	15 cm; 60g	N	S		nw	7.2	25-27	160	14d	NOEC	behaviour	>=5	3	3, 47	Anees, 1975
Clarias batrachus	35 g; 16cm	N	R	rogor					6mo	LOEC	fecundity	10.8	3	7, 47, 48, 49	Begum and Vijayaraghavan, 1995a
Cirrhinus mrigala	fingerlings; 30 mm	N	S	30%		7.2	27	60-70	30d	NOEC		6.3-6.7	2/4	20, 46	Kulshrestha *et al.*, 1986
Labeo rohita	fingerlings; 30 mm	N	S	30%		7.2	27	60-70	30d	NOEC		6.8-7.3	2/4	20, 46	Kulshrestha *et al.*, 1986
Oncorhynchus mykiss		Y	F	99			14-16		21d	NOEC	growth	0.4	2	37, 50	IUCLID, 2000: BASF AG Ludwigshafen
Oncorhynchus mykiss	juveniles, 4-6 cm	Y	R	38.9					21d	NOEC	physiology	0.29	2	1, 37, 51, 52	Caley et al, unpublished data in European Commission, 2003
Oncorhynchus mykiss	ELS test	Y	F	99.1			9.4-11.3		96d	NOEC	growth	1.5	2	19, 51, 53, 54	Strawn et al, unpublished data in European Commission, 2003
Oncorhynchus mykiss	juveniles, 2.35g; 62mm	Y	F	99			11-13.5		21d	NOEC	growth	0.4	4	1, 15, 37, 51, 55	Wuthrich, unpublished data in European Commission, 2003
Oncorhynchus mykiss										NOEC	growth	0.43	4	15, 56	US-EPA, 2006
Oryzias latipes	eggs	N	R	tech.	am	-	23	210	40d	NOEC	mortality	0.32	2	1	Slooff and Canton, 1983
Oryzias latipes	eggs	N	R	tech.	am	-	23	210	40d	NOEC	mortality/ behaviour	0.32	2	1	Slooff and Canton, 1983
Oryzias latipes	eggs	N	R	tech.	am	-	23	210	40d	NOEC	hatching growth	100	2	1	Slooff and Canton, 1983
Poecilia reticulata	3-4w	N	R	tech.	am	-	23	210	28d	NOEC	behaviour	0.1	2	1	Slooff and Canton, 1983
Poecilia reticulata	3-4w	N	R	tech.	am	-	23	210	28d	NOEC	growth	10	2	1	Slooff and Canton, 1983
Poecilia reticulata	3-4w	N	R	tech.	am	-	23	210	28d	NOEC	mortality	32	2	1	Slooff and Canton, 1983
Poecilia reticulata	2.4 cm; 0.28g	N	S	30%			23		21d	LOEC	gonad development	1	4	20, 47	Ramana *et al.*, 1992
Salmo trutta	eyed eggs	N	R	20?	nw	6.3	10	11	45d	NOEC	hatching	0.3	2	20	Grande *et al.*, 1994
Salmo trutta	eyed eggs	N	R	20?	nw	6.3	10	11	45d	NOEC	survival	0.02	2	20, 57	Grande *et al.*, 1994
Amphibia															
Rana tigrina	eggs/tadpoles	N					30-38		33d?	NOEC	metamorphosis reached?	<1	3	3, 58, 59	Dutta and Mohanty-Hejmadi, 1978; Mohanty-Hejmadi and Dutta, 1981
Xenopus laevis	<2d	N	R	tech.	am	-	20	210	100d	NOEC	mortality	1	2	1	Slooff and Canton, 1983

Species	Species properties	A	Test type	Purity [%]	Test water	pH	T [°C]	Hardness [mg $CaCO_3$. L^{-1}]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Ri[a]	Notes	Reference
Xenopus laevis	<2d	N	R	tech.	am	-	20	210	100d	NOEC	development	32	2	1	Slooff and Canton, 1983
Xenopus laevis	<2d	N	R	tech.	am	-	20	210	100d	NOEC	growth	32	2	1	Slooff and Canton, 1983

a Reliability index, according to Klimisch *et al.*, 1997

Notes:
1 Test results based on nominal concentrations
2 According to DIN 38412
3 Purity unknown
4 Survival counted on agar plates
5 5 mg/L was lowest concentration tested
6 LOEC = 200 mg/L
7 Results reported in mg/L active ingredient.
8 Stimulating effect at low concentrations (hysteresis).
9 Due to low number of replicates (2) no statistically significant difference between treatments and control.
10 LOEC is 1 mg/L (lowest concentration tested)
11 LC50 = 51 mg/L
12 According to OECD Guideline 201
13 Bottle test according to OECD guidelines
14 Measured concentrations are 40-100% of nominal concentrations
15 Probably the same study as described in IUCLID Dataset
16 Measured concentrations after 72h are 40-98% of nominal l concentrations
17 Results based on initial measured concentrations.
18 LOEC= EC14, so NOEC=LOEC/2=0.5mg/L
19 Including solvent controls
20 It is not explicitly mentioned if results are corrected for purity but probably they are. Nevertheless, if this is not the case, results in a.i. could only be lower.
21 Minimal Active dose is calculated according to Dive and Leclerc, 1975.
22 Ciliates were kept in a bacterial suspension
23 LC50 expressed as TLm50.
24 LC50 = 0.31 mg/L
25 EC50 = 0.31 mg/L
26 According to US EPA test
27 LOEC = 0.1 mg/L
28 Determined using Student's t-test
29 According to NEN 6502
30 According to NEN 6501
31 The substance was proven to be stable during the test period
32 Following guidelines by the European Commision
33 EC50 = 0.19 mg/L; LOEC = 0.17 mg/L
34 EC50 = 0.11 mg/L; LOEC = 0.124 mg/L
35 EC50 = 0.11 mg/L; LOEC = 0.047 mg/L
36 EC50 = 0.15 mgL; LOEC = 0.076 mg/L
37 According to OECD Guideline 204
38 Measured concentrations were mostly within 20% of nominal concentrations with individual exceptions
39 Results reportedly based on measured concentrations but this does not seem to be the case.
40 LOEC = 0.076 mg/L
41 According to OECD Guideline 202
42 Measured concentrations within 20% of nominal concentrations

43 LOEC = 0.1 mg/L
44 ELS test according to 'standard methods'
45 LOEC = 0.025 mg/L
46 Reported as estimated MATC
47 Only one concentration tested
48 35 g fish/L
49 Effect already significant after one month.
50 LC50 = 8.88 mg/L
51 Measured concentrations within 20% of nominal concentrations
52 LOEC = 0..91 mg/L
53 According to EPA guideline E 72-4 and GLP
54 LOEC = 3.0 mg/L
55 LOEC = 2.0 mg/L
56 LOEC = 0.84 mg/L
57 LOEC = 0.05 mg/L
58 Text and tables do not match. Concentrations in table (reported here) are a factor 10 lower than what is reported in the text. According to text experiment was finished after 33 days; metamorphosis appears to be often reached after 60 days in table.
59 According to 'standardized conditions earlier reported'.

Table A3. 4. Chronic toxicity of dimethoate to marine organisms.

Species	Species properties	A	Test type	Purity [%]	Test water	pH	T [°C]	Salinity [‰]	Exp. time	Criterion	Test endpoint	Value [mg.L^{-1}]	Notes	Ri[a]	Reference
Artemia salina	eggs		S	ag	rw	7-8	27	20	48h	NOEC	hatchability	>=10	10 mg/L was highest test concentration	2	Kuwabara *et al.*, 1980

a Reliability index, according to Klimisch *et al.*, 1997

Appendix 4 Description of aquatic mesocosm studies

Kallqvist *et al.*, 1994

Effects of four pesticides were studied on lake phytoplankton communities in enclosures (limnocorrals) for 16 days. This summary only focuses on the tests with dimethoate.

TEST DESIGN
The study was performed in enclosures of 4 m depth and 2.5 m in diameter with a total volume of 20 m^3. The enclosures were situated in oligotrophic Lake Omdalsvatn, Norway. The enclosures were filled with lake water of a depth of 0.5 – 1 m. Assumed was that the introduced lake water contained representative lake phytoplankton. Enclosures were stocked with a vertical net haul (45 µm mesh) from 10 m depth to the surface.

Application, concentrations, replicates
Two controls, 1, 10 and 100 µg dimethoate/l. No replicates of the treatments. After addition, the water was thoroughly mixed.

Sampling
Tubesamplers were used for analysis of water chemistry, chlorophyll, phytoplankton and photosynthetic activity. Per sampling event 15 – 16 l.

Biological observations
Phytoplankton was analysed for algal density and taxa using inverted microscope.
Photosynthetic activity was measured after 2, 6, 9 and 13 days. To 15 mL samples, 0.2 mL ^{14}C-labelled $NaHCO_3$ (4 µCi/ml) was added. Samples were incubated for 2 h under continuous illumination or darkness in closed bottles. Content was filtered over 0.45 µm mesh. Filters were analysed for radioactivity after addition of scintillation fluid with LSC.
After 13 days, phytoplankton communities were examined for adaptation to dimethoate. Phytoplankton from the 100 µg dimethoate/L treatment was exposed to 0, 0.1, 0.32, 1.0, 3.2 and 10 mg dimethoate/l after which photosynthetic activity was measured as described above.

Environmental conditions
Lake water contained 7 µg total P/l, 200 µg total N/L, 19 mg Ca/l (medium rich). Secchi depth was 6 m, pH 7.5-8.3. From earlier experiments in the lake, it was known that nutrient depletion occurs rapidly in the enclosures. Therefore, the water in the enclosures was enriched to 5 µg P/l and 50 µg N/l.

Verification of concentrations
Analysis of samples taken on days 0 and 16. Mode of chemical analyses was not specified.

Physical en chemical analyses
Sampling of total P, PO_4, total N and NO_3 on days 0, 2, 6, 9 and 13.

Calculations and statistics
Calculation of diversity with Shannon-Wiener index.

RESULTS

Chemical analysis
Actual concentrations at test start were 1.0, 12 and 105 µg/l and after 16 days 0.9, 11 and 101 µg/l in the 1, 10 and 100 µg/l treatments, respectively. Mean actual concentrations corresponded to 0.95, 11.5 and 103 µg/l.

Physical en chemical analyses
Control concentration of total P remained around 11 µg/l and total N between 214 and 245 µg/l during the experiment. PO_4–concentration dropped rapidly after addition below the detection limit of 1 µg/l. NO_3 declined from initial 50 µg/l to 32 µg/l after 2 days and to 1 µg/l after 6 days. These declines were attributed to uptake by the phytoplankton. Nitrate and phosphate concentrations were similar in the treatments. Only exception was an isolated increase of nitrate in the highest treatment after 6 days. This increase was thought possibly to be due to reduced assimilation of nitrate by phytoplankton.

Phytoplankton
Zooplankton density and correlated grazing activity was found to be fairly low (Hessen et al., 1994, summarized below). Therefore, variations in chlorophyll concentrations can be interpreted as direct effects of the pesticides. Initial chlorophyll concentration in the controls was 2 µg/l, increased to 4 µg/l after 6 days and declined again to 1.5 µg/l after 16 days. The increase was attributed to the addition of nutrients. Effects on chlorophyll concentration were expressed as concentration difference compared to the control. The highest treatment initially reduced the chlorophyll level (after 2 days), but chlorophyll contents returned to similar chlorophyll levels as found in the controls after 6 days. At 10 µg/l, chlorophyll levels were lower after 13 and 16 days compared to the control.
Photosynthetic activity was highest after 2 days in all enclosures. On day 2, photosynthetic activity was stimulated in the 1 µg/l treatment and inhibited in the 100 µg/l treatment compared to the control. After 6 days, photosynthetic

activity was elevated compared to the control in all treatments. On days 9 and 13, photosynthetic activity was similar to that observed in the control.

Pesticide tolerance

Assimilation was stimulated at 1 µg/l and reduced at 10 µg/l and 100 µg/l. EC_{50}-value was 20 µg/l for previously exposed algae and 30 µg/l for control algae, indicating that previously exposed plankton was more sensitive than plankton from the control enclosures.

Phytoplankton species composition

Species composition was represented by Chlorophyceae (29 taxa), Chrysophyceae (19 taxa), Cryptophyceae (8 taxa) and Bacillariophyceae (3 taxa), Cyanophyceae (2 taxa) and Dinophyceae (2 taxa). In terms of biomass, the most dominant species in the controls were Bacillarophyceae with 41-54% of total biomass, Dinophyceae (14-32%), Cryptophyceae (7-18%), Chlorophyceae (4.5-11%), Chrysophyceae (2.0-11%) and µ-algae (1.2-4.6%).

The Shannon-Weaver diversity index in the controls stayed between 2.69 and 2.76 during the 13 days experimental period. The diversity index was found to be significantly lower in all treatments with the lowest values after two days and at the end of the experiment. *Anabaena flos aqua* showed an irregular pattern during the test and did not indicate toxic effects. *Oocystis submarina* appeared to be affected by all pesticide treatments, with lower biomass concentrations compared to the controls, particularly on day 2. *Rhodomonas lacustris* var. *nannoplanctica* was affected in a dose-related fashion and a significant reduction was observed at 10 and 100 µg/l. *Cyclotella comta* was similar in all treatments and controls.

CONCLUSIONS FROM THE AUTHORS

- Species composition and diversity of the plankton community deviated from the controls at both treatment levels.
- Structural changes were induced already at no more than 1 µg/l.

EVALUATION OF THE SCIENTIFIC RELIABILITY OF THE FIELD STUDY

Criteria for a suitable (semi)field study

1. Does the test system represent a realistic freshwater community? Answer: yes.
2. Is the description of the experimental set-up adequate and unambiguous? Answer: yes. However, analytical method was not mentioned.
3. Is the exposure regime adequately described? Answer: yes.
4. Are the investigated endpoints sensitive and in accordance with the working mechanism of the compound? Answer: unclear. Sensitivity of the endpoints are difficult to judge, because results are described shortly and often in general terms. Moreover, since treatments were not replicated, variation of the endpoints can not be judged.
5. Is it possible to evaluate the observed effects statistically? Answer: no. Treatments were not replicated. Only in case of some endpoints, variation can be estimated from the controls.

It is concluded that this article only can be used for an indication of dimethoate toxicity to phytoplankton communities.

EVALUATION OF THE RESULTS OF THE STUDY

- Although there were no replicates of the treatments, it can be concluded that mean actual concentrations approached nominal concentrations, since actual concentrations in all three treatments ranged between 90 and 120% of nominal at both start and termination of the test.
- Method of chemical analyses was not specified.
- Hardly any statistics were performed, due to lack of replicates of treatments. Only differences in diversity were analyzed statistically. For chlorophyll-*a*, figures are presented and from these figures roughly can be extracted that chlorophyll content at 10 µg/l on days 13 and 16 and at 100 µg/l on days 2 and 6 is lower compared to the control. For photosynthetic activity, in the article no indication of variation around the data can be found.
- The study lasted only 13 days. Effects in all three treatments lasted longer than the treatment time. Effects on diversity were significant in all treatments. Therefore, the overall NOEC is < 0.95 µg/l on basis of mean actual concentrations.

Summary of effect classes observed for several categories of endpoints in the outdoor enclosure study treated with dimethoate.

	Treatment levels		
nominal	1.0 µg/l	10 µg/l	100 µg/l
Mean actual	0.95 µg/l	11.5 µg/l	103 µg/l
Total P	1	1	1
PO_4	1	1	1
Total N	1	1	1
NO_3	1	1	2↑
Phytoplankton responses			
Chlorophyll-*a*	1	2↓	2↓
Photosynthetic activity	2↑	1-2↑	1-2↑
Shannon-Weaver diversity index	4↓	4↓	4↓
Phytoplankton species responses			
Anabaena flos aqua	1	1	1
Oocystis submarina	2-4↓	2-4↓	2-4↓
Rhodomonas lacustris var. *nannoplanctica*	1	2-4↓	2-4↓
Cyclotella comta	1	1	1
Most sensitive endpoint	4↓	4↓	4↓

Hessen *et al.*, 1994

Effects of four pesticides were studied on lake zooplankton communities in pelagic enclosures for four weeks. This summary only focuses on the tests with dimethoate.

TEST DESIGN
The study was performed in enclosures of 4 m depth and 2.5 m in diameter with a total volume of 22 m^3. The enclosures were situated in oligotrophic Lake Omdalsofn, Norway. The enclosures were filled with lake water of a depth of 0.5 – 1 m. Assumed was that the introduced lake water contained representative lake phytoplankton. Enclosures were stocked with a vertical net haul (45 µm mesh) from 6 m depth to the surface.

Application, concentrations, replicates
Two controls, 1, 10 and 100 µg dimethoate/l. No replicates of the treatments. After addition, the water was thoroughly mixed.

Sampling
Tubesamplers were used for analysis of water chemistry, chlorophyll, phytoplankton and photosynthetic activity. Per sampling event 15 – 16 l.

Biological observations
Zooplankton and phytoplankton samples were taken on days 2, 6, 9 and 12 with a 10-l hose. Because of low concentrations of macrozooplankton, the effects on the crustacean zooplankton community could not based on the daily quantitative samples. Thus, effects on this community were based on the cumulative samples. Rotifers were high in density throughout the experiment, allowing a day-to-day evaluation.
Photosynthetic activity was measured after 2, 6, 9 and 13 days. To 15 mL samples, 0.2 mL ^{14}C-labelled $NaHCO_3$ (4 µCi/ml) was added. Samples were incubated for 2 h under continuous illumination or darkness in closed bottles. Content was filtered over 0.45 µm mesh. Filters were analysed for radioactivity after addition of scintillation fluid with LSC.

Environmental conditions
Lake water was reported to contain 7 µg total P/l, 200 µg total N/L, 19 mg Ca/l (medium rich). Secchi depth was 6 m, pH 7.5-8.3. From earlier experiments in the lake, it was known that nutrient depletion occurs rapidly in the enclosures. Therefore, the water in the enclosures was enriched to 5 µg P/l and 50 µg N/l.

Verification of concentrations
Analysis of samples taken on days 0 and 16. Mode of chemical analyses was not specified.

Physical en chemical analyses
-

Calculations and statistics
Interaction between phyto- and zooplankton were tested by Spearman rank correlation coefficient.

RESULTS

Chemical analysis

Actual concentrations at test start were 1.0, 12 and 105 µg/l and after 16 days 0.9, 11 and 101 µg/l in the 1, 10 and 100 µg/l treatments, respectively. Mean actual concentrations corresponded to 0.95, 11.5 and 103 µg/l.

Physical en chemical analyses

-

Zooplankton

Rotifer communities in both lake and bags were almost exclusively composed of *Conochilus unicornis*, *Kelicottia loniseta*, *Polyarthra* sp. and *Asplanchna priodonta*. The authors reported that no clear-cut effects were revealed from comparison of numbers among bags, mainly due to density oscillations with all bags. Comparing total number of individuals minus the colony-building *C. unicornis* declined in all bags, including the controls. For *K. loniseta* and *Polyarthra* was reported that these species had a more or less similar response to all treatments. *A. priodonta* was negatively affected by 100 µg/l.

The crustacean community was composed of copepod *Acanthodiaptomus gracilis* and cladocerans *Holopedium gibberum*, *Bosmina longispina*, *Daphnia longispina*, *Ceriodaphnia quadrangular* and *Sida crystalline*. Evaluation of crustacean community after two days was not possible because of low numbers of all species. Numbers found at test termination are presented in the table below.

Final net-haul numbers of crustacean zooplankton in the bags at the experimental termination. Table is copied from the original article.

	copepods	*Sida*	*Holopedium*	*Bosmina*	*Ceriodaphnia*	*Daphnia*
Control	12	2	1	2	5	2
Control	27	2	2	1	1	-
1 µg/l	104	11	6	16	9	7
10 µg/l	105	140	2	9	2	-
100 µg/l	42	-	-	-	-	-

CONCLUSIONS FROM THE AUTHORS

The authors reported that a pronounced effect was found at the highest concentration where all cladocera disappeared.

EVALUATION OF THE SCIENTIFIC RELIABILITY OF THE FIELD STUDY

Criteria for a suitable (semi)field study

1. Does the test system represent a realistic freshwater community? Answer: yes.
2. Is the description of the experimental set-up adequate and unambiguous? Answer: yes. However, analytical method was not mentioned.
3. Is the exposure regime adequately described? Answer: yes.
4. Are the investigated endpoints sensitive and in accordance with the working mechanism of the compound? Answer: unclear. Sensitivity of the endpoints is difficult to judge, because results are described shortly and often in general terms. Moreover, since treatments were not replicated, variation of the endpoints can not be judged.
5. Is it possible to evaluate the observed effects statistically? Answer: no. Treatments were not replicated. Only in case of crustaceans, variation can be estimated from the controls. For rotifers, effects or trends were only described in general terms.

EVALUATION OF THE RESULTS OF THE STUDY

Although there were no replicates of the treatments, it can be concluded that mean actual concentrations approached nominal concentrations, since actual concentrations in all three treatments ranged between 90 and 120% of nominal at both start and termination of the test.

Method of chemical analyses was not specified.

Hardly any statistics were performed, due to lack of replicates of treatments. However, numbers of crustaceans were presented and from these can be concluded that 100 µg/l has an effect on crustacean community. For the 1 and 10 µg/l treatments, elevated levels of *Sida* and copepods compared to controls seemed to be present at test termination. Also, on basis of simple multivariate statistics with the data presented in the table above, all three treatments affect the crustacean community significantly.

For rotifers only total numbers were evaluated. Therefore, no evaluation of effects in time can be done.

For *K. loniseta* and *Polyarthra* was reported that these species had a more or less similar response to all treatments. This remark probably means that no effect of treatment was observed, but might also mean that all treatments had effect but were similar between pesticides.

Drawing a conclusion is hardly possible on basis of the information given in the article. However, by means of statistics significant effects on *A. priodonta* at 100 µg/l are determined (by authors) and on crustacean community (by evaluator). Therefore, the NOEC is < 0.95 µg dimethoate/l.

Summary of effect classes observed for several categories of endpoints in the outdoor enclosure study treated with dimethoate. Only the results based on statistics are presented.

	Treatment levels		
nominal	1.0 µg/l	10 µg/l	100 µg/l
mean actual	0.95 µg/l	11.5 µg/l	103 µg/l
Rotifers			
Asplanchna priodonta			4↓
Total crustaceans	4↑	4↑	4↓
Most sensitive endpoint	4↑	4↑	4↓

Baekken and Aanes, 1994

Effect of 1 µg dimethoate/l were tested on an autumn (August/September) and a spring (May/June) benthic macroinvertebrate community in indoor experimental streams.

TEST DESIGN
The study was performed in experimental streams of 5 m long. Water was circulated at 2 and 10 cm/s and originated directly from a drinking-water source. Invertebrates were introduced by placing ten trays, colonized by natural stream biota for five weeks, in each experimental stream. Trays were 15·116 cm^3 and contained sand, gravel and pebbles. Per experimental stream, 40 medium-sized individuals of *Baetis rhodani* were introduced in the spring experiment to increase densities of this taxa

Application, concentrations, replicates
Per test one control and one treatment of 1 µg dimethoate/l.

Biological observations
One part of the stream water was channeled into a net and pumped back again. The number of drifting animals was counted every 24 hours. Animal movements away from the trays were also determined.

Environmental conditions
Water temperature was 15ºC, pH 6.6, conductivity 3.4 mS/m, alkalinity 0.09 mmol/l, TOC 2.4 mg C/l, 300 µg total N/l and 4.5 µg total P.

Verification of concentrations
-

Physical en chemical analyses
-

Calculations and statistics
-

RESULTS

Drift

The autumn stream test
Total number of drifting animals was higher in the treatment than in the reference stream with totals of 518 and 353 individuals, respectively. Except for the last two weeks having almost no drift at all, the average number of drifting animals was always equal or higher in the treatment stream than in the control stream. Tendency for drifting was different among taxa. For example, almost 100% of the total population of chydorids was found in the drift fauna, whereas drifting beetle larvae were not observed. A total of 10.4% and 6.8% of individuals of the benthic macroinvertebrate communities were caught in the drift fauna of the treated and untreated stream, respectively. From a figure (no. 3 of the article) only a marked increase of drift can be observed for *Hydracarina*, but drift numbers of *Hydracarina* were only 57 in the treatment and 30 in the control.

The spring stream test
Total number of drifting animals was 1239 in the treatment and 982 in the control stream. It was reported that mostly the average daily drift rate for total drift fauna was higher in the treated stream compared to the control stream. Drift rates varied between 24 and 68 individuals/day in the treated stream and between 13 and 82 individuals/day in the control stream. Chironomids and stoneflies made up most of the drifting animals. For chironomids only small differences between treated and untreated streams were observed. Most of the time stoneflies were caught in

considerably higher numbers in the treated stream. A total of 463 and 302 *Leuctra* sp. were found in the dimethoate and control stream, respectively. *Baetis* sp. was found in total numbers of 84 and 118 individuals, chydorids of 128 and 15 individuals and a total of 28% and 24% of invertebrate individuals were caught in the drift fauna, respectively.

Other movements

The autumn stream test

Of the mayfly fauna, 70% was found outside the trays in the treated stream and 54% in reference stream. Total percentage of individuals moved outside the trays was 22% and 19%, respectively.

The spring stream test

Mayflies moved outside the trays in percentages of 68% and 55%, respectively. *Baetis rhodani* moved away in percentages of 36% and 32%, respectively.

Structural changes

The autumn stream test

Nine out of 13 populations had a lower number of individuals in the dimethoate stream than in the reference steam at the end of the experiment. In both streams, total number of animals was almost doubled during the experimental period. This was mostly cause by an increase of newly hatched stonefly species, with the exception of *Leuctra digitata* whose abundance was reduced by two-thirds from start to end of the experiment. The abundance of mayflies was low both at start and end of the experiment. Most common species was *Paraleptophlebia* sp., which had an equal abundance in both streams.

The spring stream test

At the end of the experiment there was approximately the same number of animals in the treated and reference streams. However, there were differences between the taxa. Oligochaetes, dipterans and chironomid pupae were more abundance in the dimethoate stream, whereas mayflies, ostracods and copepods were less abundant. For mayflies and ostracods, differences were reported to be significantly different. For the other taxa, only minor differences were found. Total number of animals was reported to be considerable reduced during the experiment, mainly due to reduction of young stonfly of the genu *Leuctra* and chironomids. However, reductions were of the some order of magnitude in both streams. Mayflies, mainly *Baetis rhodani*, were significantly more reduced in the treated stream.

CONCLUSIONS FROM THE AUTHORS

- Drift rate was higher in the dimethoate stream
- Non-drifting movements away from the trays were higher in the dimethoate stream

EVALUATION OF THE SCIENTIFIC RELIABILITY OF THE FIELD STUDY

Criteria for a suitable (semi)field study

1. Does the test system represent a realistic freshwater community? Answer: unclear. The organisms were sampled with colonizing trays and therefore represent a part of a freshwater community. The physical interior of the streams was not described. Thus, this question can not be answered fully.
2. Is the description of the experimental set-up adequate and unambiguous? Answer: yes.
3. Is the exposure regime adequately described? Answer: no. No analytical method was described. Therefore, actual exposure can not be estimated. However, since the systems were flow-through systems it is assumed that actual concentrations approach the nominal concentration.
4. Are the investigated endpoints sensitive and in accordance with the working mechanism of the compound? Answer: unclear. Sensitivity of the endpoints are difficult to judge, because results are described shortly and often in general terms. Moreover, since control and treatment were not replicated, variation of the endpoints can not be judged.
5. Is it possible to evaluate the observed effects statistically? Answer: yes. Treatment and control were not replicated, but the whole community as a whole can be tested.

EVALUATION OF THE RESULTS OF THE STUDY

Effects are described mostly in general terms. For mayflies and ostracods in the spring experiment, differences were reported to be significantly different. However, no description of statistics was given.

Actual concentrations were not determined. Water was circulated. Therefore, actual concentrations probably declined during the 4-weeks study.

From the rough data no differences can be extracted, due to lack of replicates. By means of paired t-tests a first crude analysis was made, but no significant difference was found between reference and treatment communities for both the autumn and spring test. Also replicated observations (pairing autumn and spring data), gave no significant difference for any of the taxa.

Differences of individual taxa and whole community were minor between control and treatment. Therefore, it is concluded that treatment by 1.0 µg/l did not affect the stream community. NOEC for the autumn and spring streams is 1 µg/l on basis of nominal concentration.

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