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Quality Targets for Active Ingredients of Pesticides to Protect Inland Surface Waters

by

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Preface

The model of modern-day environmental protection is characterized by the term „sustainable development". In 1992, the United Nations Conference on Environment and Development in Rio de Janeiro formed the basis for a new quality in worldwide political co-operation in both fields.
In the years to come, one of the key issues will be to put the concept of sustainable development into concrete terms and into praxis.

Water protection policy has to cope with the questions, which environmental quality objectives should be pursued in the long run, which demands should be made today and which instruments should be developed and used to put them into practice.

In view of a unified Europe, most involved parties have realized that a sustainable and acceptable environmental quality cannot be achieved by emission decreasing measures alone. Especially with regard to the precautionary principle it has become necessary to develop and determine immission-related quality targets and add them to the uniform emission limit value approach which is aligned to the state of the art.

In the past years, a federal government/federal states working group, in co-operation with the German Federal Environmental Agency (*Umweltbundesamt*) and various interest groups, has worked out a methodology to derive quality targets in order to protect inland surface waters from hazardous substances.

These quality targets help to check if the concentrations of substances in inshore waters are within a certain range and if additional protective measures are required. The quality targets are scientifically substantiated concentration data and should be regarded as reference values and guidelines rather than legally binding limit values.

Compliance with the defined quality targets guarantees that the protected asset in question is not jeopardized according to the current level of scientific knowledge.
If quality targets are exceeded, it is recommended to explore the reasons, take steps to reduce water pollution and evaluate the outcome of remediation measures.

In addition, this approach serves as the main basis and a connecting link to support the activities of the International Commission for the Protection of the Rhine (ICPR) and the European Union (EU).

According to the European Council Directive 76/464/EEC, Germany is committed to determine quality targets for hazardous substances in water bodies. It is intended that this directive become a framework directive in the future.
The European Commission has presented a proposal for a Council Directive on creating a regulatory framework regarding Community water policy (water framework directive). Article 4 of the amended proposal for a framework directive on water policy establishes environmental quality objectives for surface waters, groundwater and protected areas. The overall objective is to achieve a good condition for all water bodies.
In addition, the water framework directive proposal contains default conditions to derive quality standards for the protection of water organisms. The described procedures to determine chemical quality standards are basically similar to the derivation methods of the German Laender Working Commission Water (*Länderarbeitsgemeinschaft Wasser* / LAWA 1997).

Introduction

Quality targets are reference values and guidelines with regard to a particular protected asset and serve as a benchmark for the quality of surface waters. After quality targets had previously been determined for 28 industrial chemicals and 7 heavy metals, this new publication now describes the derivation of quality targets for 35 active ingredients of pesticides with regard to aquatic communities, a particular protected asset.

The choice of the 35 active ingredients was brought into agreement with representatives of the BBA (Federal Biological Research Centre for Agriculture and Forestry), the BML (Ministry of Agriculture) and the LAWA.

Certain ingredients are listed because they were detected in surface waters by the monitoring-programs of the federal states, although they are no longer authorized in Germany.

A detailed explanation of the quality targets derivation procedures is given in the LAWA publication „*Konzeption zur Ableitung von Zielvorgaben zum Schutz oberirdischer Binnengewässer vor gefährlichen Stoffen*" (Concept to Derive Quality Targets to Protect Inland Surface Waters from Hazardous Substances)(LAWA 1997).

In its groundwork for the LAWA working group on water quality, the Federal Environmental Agency has derived substantiated quality targets for 35 active ingredients and listed them in data sheets. In a written hearing, all affected parties were given an opportunity to state their opinions. In many cases these statements led to a revision of the data sheets.

Quality targets serve to define a required water quality for a particular protected asset considering the overall pollution regardless of the individual polluting sources. Even iflegally bindung technical standards are observed, harmful effects on human health and the environment cannot be excluded, e.g. due to a high regional density of industrial plants, traffic and transport, private or agricultural use of chemical products etc.

The objective for a particular protected asset – aquatic communities – is to maintain or restore a community of plants and animals in a certain water body or stretch of water which is as natural, site-specific, self-reproducing and self-regulating as possible. To protect an aquatic community means to safeguard the protection of every single community member. The quality targets were determined after extensive research regarding the toxic effects of each substance in the water. In each case the lowest valid results from ecotoxicological tests on four trophic levels of water biocenosis (bacteria, green algae, small crustaceans and fish) were used to derive quality targets.

The data are generated by applying generally accepted test methods that provide information about the highest concentration which will have no observable effect (No Observed Effect Concentration, NOEC) at prolonged exposure. In order to take into account the uncertainty inherent in extrapolating test results obtained in the laboratory from a small number of single water organism species to field conditions, the lowest test result for the most sensitive species is usually multiplied by a 0.1 "compensation factor". Another compensation factor may be applied if additional risk factors exist.

Quality targets are concentration limits that should not be exceeded if at all possible. They should be regarded as reference values or guidelines rather than legally binding limit values. The quality target approach serves to define a quality standard for surface waters. A comparison of actual pollution data with the quality targets for pesticides reveals that increased efforts are necessary to reduce water pollution.

A large number of quality targets in this publication is lower than the corresponding statutory limit values of the Drinking Water Decree. Thus the limit value for drinking water which was originally defined as a precautionary measure is supported by more stringent quality targets for aquatic communities while the demand for effect-related water quality objectives is met.

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Glossary

Acute: Acute toxicity is the harmful effect of a substance or physical impact after a short-term exposure or uptake.

Aquatic community (AC): An AC is a community of various reciprocally interconnected populations of aquatic organisms in a stretch of water or habitat.

BBA: Biologische BundesAnstalt (Federal Biological Research Centre for Agriculture and Forestry)

BMU: Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, (Federal Ministry of Environment, Nature Conservation and Reactor Safety

Bioaccumulation factor (BAF): The ratio of the concentration of a given compound in the tissues of an organism and its concentration either in the media in which the organism lives or in the tissues of the biota on which the organism feeds.

Bioconcentration factor (BCF): The ratio of the concentration of a given compound in the tissues of an organism and its concentration in the media in which the organism lives

Chronic: In toxicology, the term "chronic" is used for a test duration exceeding 10% of an organism's lifespan. In aquatic ecotoxicology the test duration depends on the tested species and should comprise at least one entire reproductive cycle. The statistical endpoints to be determined include mortality, growth and reproduction. Frequent parameters (final statistical values) are the NOEC (no observed effect concentration), the NOEL (no observed effect level), the LOEC (lowest observed effect concentration) and the LOEL (lowest observed effect level). The statistical endpoints resulting from a prolonged short-term test or an Early life-stage test are often referred to as "subchronic" or "semichronic" effect values.

Detection limit: In an analytical procedure, the smallest concentration of a substance that can be qualitatively distinguished with a specified degree of statistical certainty (e.g. P=95%) from the amount zero.

Determination limit: In an analytical procedure, the smallest concentration of a substance that can be quantitatively distinguished with a specified degree of statistical certainty (e.g. P=95%) from the amount zero. Also referred to as "Quantification limit".

Early life-stage test: 28 to 32 days (60 days for salmonids) exposures of the early life stages of a species of fish from shortly after fertilization through embryonic, larval and early juvenile development. Data are obtained on survival and growth.

EC (effective concentration): The concentration of a substance that is estimated to be effective in producing a biological response, other than mortality, in a certain percentage of the test organisms over a specific time interval.

EC10: The concentration (with regard to a certain test criterion) of a substance which will cause a toxic effect in 10% of the organisms exposed to it over a specific time intervall .

EC50: The concentration (with regard to a certain test criterion) of a ssubstance which will cause a toxic effect in 50% of the organisms exposed to it over a specific time intervall .

Endpoint (statistical endpoint): Parameter determined at the end of a biotest, e.g. mortality, cell multiplication, growth rate. The statistical parameter characteristic of a test result (e.g. LC50, LOEC, NOEC) is also referred to as "endpoint" or "statistical endpoint".

EPA: Environmental Protection Agency of the US, Washington D.C.

Field test: Experimental tests of toxic effects caused by chemicals in biotic and abiotic system components under natural or near natural conditions.

Full life-cycle test: See Life-cycle test.

LC (lethal concentration): Concentration that causes death in a toxicity test

LC50: Concentration that kills 50% of the organisms exposed to the test conditions within a set time period..

Life-cycle test: A chronic test which exposes an organism in all its important life stages to a certain test substance. Generally, a life-cycle test comprises an entire reproductive cycle of the organism. There is a distinction between a full (complete) and a partial life-cycle test. A full life-cycle test with fish includes the exposure of embryos, larvae, young fish and adults of the F1 generation as well as the embryonic and larval development of the F2 generation. A partial life-cycle test includes the effect on egg production and a subsequent early life-stage test.

LOEC (lowest observed effect concentration): The lowest concentration of a test substance that has a statistically significant adverse effect in a longer-term test as compared with the controls, e g. death of parent animals, reduced reproduction rate or other biologically relevant parameters. The LOEC value is numerically equivalent to the "upper limit" of a MATC (Maximum Acceptable Toxicant Concentration) value or to the "chronic value".

LOEL (lowest observed effect level): The lowest dose or concentration of a substance that causes a recognizable effect or a recognizable adverse effect (LOAEL, lowest observed adverse effect level) in the test organism after continuous feeding.

Mortality: The ratio of the number of deaths to the total population during a set time period. The ratio of reproduction to mortality is the decisive factor in the increase or decrease of a population.

NOEC (no observed effect concentration): The highest concentration of the test substance which causes no death among the parent animals, no reduced reproduction rate, no delay in the first emergence of offspring and no adverse effect on any other biologically relevant parameter in a longer-term test as compared to the controls.

NOEL (no observed effect level): The highest dose or concentration of a substance that causes neither a recognizable effect nor any recognizable adverse effect (NOAEL, no observed adverse effect level) in the tested organism after continuous feeding.

Toxicity: The inherent potential of a chemical substance to cause adverse effects in humans, animals and plants. There is a distinction between acute toxicity (after a one-time uptake of the active ingredient), subacute toxicity (after repetitive uptake within a short time period) and chronic toxicity (after continuous long-term uptake, e.g. several years).

UBA: Umweltbundesamt, Federal Environmental Agency

Quality Targets (Overview)

Substance	Quality Target for Aquatic Communities (µg/l)	Quality Target for Drinking Water Supply (µg/l)
Ametryn	0.5	0.1
Azinphos-methyl	0.01	0.1
Bentazon	70	0.1
Bromacil	0.6	0.1
Chloridazon	10	0.1
Chlorotoluron	0.4	0.1
2,4-D	2.0	0.1
Dichlorprop-P	10	0.1
Dichlorvos	0.0006	0.1
Dimethoate	0.2	0.1
Diuron	0.05	0.1
Endosulfan	0.005	0.1
Etrimphos	0.004	0.1
Fenitrothion	0.009	0.1
Fenthion	0.004	0.1
Hexazinone	0.07	0.1
Isoproturon	0.3	0.1
Lindane	0.3	0.1
Linuron	0.3	0.1
Malathion	0.02	0.1
MCPA	2.0	0.1
Mecoprop-P	50	0.1
Metazachlor	0.4	0.1
Methabenzthiazuron	2.0	0.1
Metolachlor	0.2	0.1
Parathion-ethyl	0.005	0.1
Parathion-methyl	0.02	0.1
Prometryn	0.5	0.1
Simazine	0.1	0.1
Terbuthylazine	0.5	0.1
Triazophos	0.03	0.1
Trifluralin	0.03	0.1
Organotin compounds		0.1
Tributyltin compounds	0.0001	0.1
Triphenyltin compounds	0.0005	0.1

Data Sheets

Ametryn
N-ethyl-*N'*-(1-methylethyl)-6-(methylthio)-1,3,5-triazine-2,4-diamine
CAS Number: 834-12-8

Quality Target

Protected Asset	Water (µg/l)
Aquatic Communities	0.5
Drinking Water Supply	0.1

1. General

Ametryn is a selective herbicide from the triazine chemical family. After being absorbed through the leaves and roots it moves upwards acropetally through the xylem and accumulates in the apical meristems. Ametryn inhibits photosynthesis and other fermenting processes. It is applied as a pre- and post-emergence herbicide.
Pesticides containing the active ingredient ametryn are not authorized in Germany (BBA, 1998).

2. Aquatic Communities

Results from longer-term tests to assess the ecotoxicological effects are available for algae, crustaceans and fish. No data are available for bacteria. Due to the mode of action it is assumed that tests on bacteria are not relevant to the derivation of quality targets. The most sensitive test results are listed in section 4. The lowest NOEC value was recorded for algae (Ankistrodesmus falcatus) at 5 µg/l.

The quality target for aquatic communities was derived by multiplying the value of the most sensitive alga species by the compensation factor F1 = 0.1.
(QT = 5µg/l x 0.1 = 0.5 µg/l). The quality target for ametryn is 0.5 µg/l.

3. Drinking Water Supply

The maximum value of 0.1 µg/l determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is 0.1 µg/l.

4. Test Results

Species	Effect	Time		Value	Conc. [µg/l]	Reference
Ametryn						
834-12-8						
Algae						
Selenastrum capricornutum	no data	7	d	EC50	3.67	EPA 1995
Ankistrodesmus falcatus	growth	12	d	NOEC	5	Tscheu-Schlüter 1976
Ankistrodesmus falcatus	growth	12	d	LOEC	7	Tscheu-Schlüter 1976
Isochrysis galbana	oxygen production	1	h	EC50	10	Hollister & Walsh 1973
Phaeodactylum tricornutum	oxygen production	1	h	EC50	10	Hollister & Walsh 1973
Chlorococcum sp.	oxygen production	1	h	EC50	10	Hollister & Walsh 1973
Ankistrodesmus falcatus	growth	12	d	EC50	16	Tscheu-Schlüter 1976
Crustaceans						
Daphnia magna	no data	21	d	LOEC	740	EPA 1995
Mysidopsis bahia	no data	4	d	LC50	2300	EPA 1995
Fish						
Lebistes reticulatus	mortality	4	d	LC50	300	Bathe et al. 1972
Lebistes reticulatus	mortality	2	d	LC50	500	Bathe et al. 1972
Pimephales promelas	no data	35	d	LOEC	1400	EPA 1995
Oncorhynchus mykiss	mortality	4	d	LC50	3400	Bathe et al. 1972
Oncorhynchus mykiss	mortality	2	d	LC50	7000	Bathe et al. 1972

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Azinphos-methyl
CAS Number: 86-50-0

Quality Target

Protected Asset	Water (µg/l)
Aquatic Communities	0.01
Drinking Water Supply	0.1

1. General

Azinphos-methyl is an insecticide and acaricide that inhibits choline esterase activity. It is used in vineyards to control vine leaf-rollers and grape berry moths (2nd generation). Pesticides containing the active ingredient azinphos-methyl are not authorized in Germany (BBA, 1998).

2. Aquatic Communities

NOEC data from longer-term tests to assess the ecotoxicological effects are available for algae, crustaceans and fish. For bacteria only an EC50 value is available which is three orders of magnitude higher than the lowest results for crustaceans and fish. The most sensitive species are found among crustaceans and fish.

The acute effect data are often similar to the NOEC values from longer-term tests. The lowest LOEC measured during a test period of 21 days for Daphnia magna (0.1 µg/l) is used to derive the quality target. The quality target was derived by multiplying this value (0.1) by the compensation factor F1 = 0.1.
(QT = 0.1 µg/l x 0.1 = 0.01 µg/l). The quality target for azinphos-methyl is 0.01 µg/l.

3. Drinking Water Supply

The maximum value of 0.1 µg/l determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is 0.1 µg/l.

4. Test Results

4.1 Aquatic Toxicity

Species	Effect	Time		Value	Conc. [µg/l]	Reference
Azinphos-methyl 86-50-0						
Bacteria						
Photobacterium phosphoreum	bioluminescence	15	min	EC 50	315	Kadlec & Benson 1995
Algae						
Scenedesmus subspicatus	cell multiplication (biomass)	4	d	NOEC	1800	PSM database
Scenedesmus subspicatus	no data	4	d	LOEC	3200	PSM database
Scenedesmus subspicatus	cell multiplication (biomass)	4	d	EC 50	3610	PSM database
Scenedesmus subspicatus	cell multiplication (growth)	4	d	EC 50	7150	PSM database
Crustaceans						
Daphnia magna	immobilization	21	d	LOEC	0.1	Dortland 1980
Daphnia magna	reproduction, immobilization	21	d	NOEC	0.25	PSM database
Daphnia magna	reproduction, mortality	21	d	LOEC	0.4	PSM database
Daphnia magna	immobilization	10	d	EC 50	0.43	PSM database
Daphnia magna		1	d	EC 50	0.18	Frear & Boyd 1967
Gammarus fasciatus	mortality	4	d	LC 50	0.1	Sanders 1972
Gammarus lacustris	mortality	4	d	LC 50	0.15	Sanders 1969
Palaemonetes kadiakensis	mortality	4	d	LC 50	0.13	Sanders 1972
Palaemonetes kadiakensis	mortality	20	d	LC 50	0.16	Sanders 1972
Fish						
Carassius auratus	mortality	4	d	LC 50	1040	Holocomb et al. 1987
Cyprinodon variegatus* (adults)	mortality	7	d	LC	2	Cripe et al. 1984
Cyprinodon variegatus* (fish fry)	mortality	28	d	LC 100	1	Cripe et al. 1984
Cyprinodon variegatus*	reproduction	14	d	EC	0.5	Cripe et al. 1984
Ictalurus punctatus	mortality	4	d	LC 50	3220	Holocomb et al. 1987
Lepomis macrochirus	mortality	4	d	LC 50	9.3	Holocomb et al. 1987
Oncorhynchus mykiss (early life-stage test)	growth	47	d	NOEC	0.18	PSM database
Oncorhynchus mykiss (early life-stage test)	growth	47	d	EC 10	0.29	PSM database

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Oncorhynchus mykiss (early life-stage test)	growth	47	d	EC 50		0.67	PSM database
Oncorhynchus mykiss (early life-stage test)	mortality	47	d	NOEC		0.47	PSM database
Oncorhynchus mykiss (early life-stage test)	mortality	47	d	LC 50		0.61	PSM database
Oncorhynchus mykiss (early life-stage test)	multiplication	85	d	NOEC		0.23	PSM database
Oncorhynchus mykiss (early life-stage test)	multiplication	85	d	LOEC		0.44	PSM database
Oncorhynchus mykiss (early life-stage test)	growth	85	d	LC 50		0.98	PSM database
Oncorhynchus mykiss (early life-stage test)	multiplication	4	d	NOEC		1	PSM database
Oncorhynchus mykiss (early life-stage test)	multiplication	4	d	LC 50		3	PSM database
Oncorhynchus mykiss	mortality	4	d	LC 50		9.1	Holocomb et al. 1987
Pimephales promelas	fertility (eggs/spawning date or female)	250	d	NOEC		0.33	Adelmann et al. 1976
Pimephales promelas	mortality	4	d	LC 50		65	Holocomb et al. 1987
Other Species and/or Parameters							
Fish							
Carassius auratus	AChE inhibition	15	d	TC		1	Weiss & Gakstatter 1964
Cyprinodon variegatus*	AChE inhibition	107	d	EC		0.06	Cripe et al. 1984
Lepomis macrochirus	AChE inhibition	15	d	TC		1	Weiss & Gakstatter 1964
Lepomis machrochirus (field study)	reproduction, hatching rate, mortality, biomass	63	d	NOEC	≥	4	Tanner & Knuth 1995
Lepomis machrochirus (field study)	mortality	8	d	LC 100	≥	6	Tanner & Knuth 1995
Protozoa							
Colpidium campylum	population growth	43	h	LC 50		1000	Dive et al. 1980

* = salt water and brackish water organism

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Bentazon

3-(1-methylethyl)-1*H*-2,1,3-benzothiadiazin-4(3*H*)-one 2,2-dioxide
CAS Number: 25057-89-0

Quality Target

Protected Asset	Water (µg/l)
Aquatic Communities	70
Drinking Water Supply	0.1

1. General

Bentazon is a contact herbicide from the diazine chemical family. It is absorbed through the leaves and sprouts and through the root system. Bentazon inhibits the Hill reaction and disturbs photosynthesis.
It is mainly applied as a post-emergence herbicide to control dicotyledonous weed. Although pesticides containing the active ingredient bentazon are authorized in Germany (BBA, 1998), they are subject to restrictions in use.

2. Aquatic Communities

Results from longer-term tests to assess the ecotoxicological effects are available for bacteria, algae, crustaceans and fish. The most sensitive test results are listed in section 4. The lowest value was recorded for algae (Pseudokirchneriella sub.) with an NOEC of 732 µg/l.

The quality target for aquatic communities was derived by multiplying the NOEC of the most sensitive alga species by the compensation factor F1 = 0.1.
(QT = 732 µg/l x 0.1 = 73.2 µg/l, rounded 70 µg/l).

3. Drinking Water Supply

The maximum value of 0.1 µg/l determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is 0.1 µg/l.

4. Test Results

Species	Effect	Time	Value		Conc. [µg/l]	Reference
Bentazon						
25057-89-0						
Bacteria						
Proteolytic micro-organisms	no data		NOEC		1000	IKSR, Bazin & Chambon 1980
Algae						
Ankistrodesmus bibraianus	no data	4 d	NOEC	<	980	BBA 1993
Ankistrodesmus bibraianus	no data	4 d	NOEC		1950	PSM database
Chlorella fusca	growth	1 d	EC50		42500	Faust et al. 1993
Ankistrodesmus bibraianus	no data	4 d	EC50		47300	PSM database 1994
Ankistrodesmus bibraianus	no data	4 d	LC50		47400	BBA 1993
Crustaceans						
Daphnia magna	no data	2 d	NOEC		62500	BBA 1993
Daphnia magna	no data	21 d	NOEC		120000	PSM database 1994
Daphnia magna	no data	2 d	LC50		125000	BBA 1993
Fish						
Cyprinus carpio	no data	21 d	NOEC	>	20000	BBA 1993
Oncorhynchus mykiss	no data	21 d	NOEC		48000	PSM database 1994
Perca flavescens	no data	4 d	LC50		100000	PSM database 1994
Oncorhynchus mykiss	no data	4 d	NOEC	>	100000	BBA 1993
Oncorhynchus mykiss	no data	4 d	LC50		190000	BBA 1993
Bentazon sodium salt						
Algae						
Pseudokirchneriella sub	biomass	3 d	NOEC		732	PSM database 1994
Lysimeter percolate						
Crustaceans						
Daphnia magna	no data	2 d	EC0		11.4	PSM database 1994
Fish						
Brachydanio rerio	no data	4 d	LC0		11.4	PSM database 1994

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Additive effects of herbicide combinations on aquatic non-target organisms.
The Science of the Total Environment, Supplement 1993 Elsevier Science Publishers B. V., Amsterdam, 941-952

PSM-Datenbank (PSM database),
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Bromacil

5-bromo-6-methyl-3-(1-methylpropyl)-2,4(1*H*,3*H*)-pyrimidinedione
CAS Number: 314-40-9

Quality Target

Protected Asset	Water (µg/l)
Aquatic Communities	0.6
Drinking Water Supply	0.1

1. General

Bromacil is a non-selective herbicide from the diazine chemical family. It is quickly absorbed through the roots, only little enters the plant through the leaves. Inside the plant it moves upwards through the xylem at a low transport rate. Bromacil inhibits photosynthesis, particularly the electron transport in the photosystem II. It is primarily applied to control grass and weed on non-cropland areas. It is often used in combination with other herbicides. Pesticides containing the active ingredient bromacil are not authorized in Germany (BBA, 1998).

2. Aquatic Communities

Results from long-term tests to assess the ecotoxicological effects are available for algae and fish. Only data from acute tests are available for crustaceans. No data are available for bacteria. Due to the mode of action it is assumed that tests on bacteria are not relevant to the derivation of quality targets. The most sensitive test results are listed in section 4. The lowest value from long-term tests was recorded for algae (Scenedesmus subspicatus) with an NOEC 24h of 6 µg/l.

The quality target for aquatic communities was derived by multiplying the NOEC of the most sensitive alga species by the compensation factor F1 = 0.1.
(QT = 6 µg/l x 0.1 = 0.6 µg/l).

3. Drinking Water Supply

The maximum value of 0.1 µg/l determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is 0.1 µg/l.

4. Test Results

Species	Effect	Time	Value	Conc. [µg/l]	Reference
Bromacil					
314-40-9					
Algae					
Scenedesmus subspicatus	photosynthetic rate	1 d	NOEC	6	Schäfer et al. 1994
Selenastrum capricornutum	no data	5 d	EC50	6.8	EPA 1995
Scenedesmus subspicatus	growth	1 d	NOEC	24	Schäfer et al. 1994
Scenedesmus subspicatus	growth	3 d	NOEC	45	Schäfer et al. 1994
Scenedesmus subspicatus	growth	3 d	EC50	97	Schäfer et al. 1994
Crustaceans					
Mysidopsis bahia	no data	4 d	LC50	1000	PSM database 1980
Penaeus aztecus	mortality	2 d	LC50	1000	EPA 1995
Fish					
Leiostomus xanthurus	mortality	2 d	LC50	1000	EPA 1995
Oncorhynchus mykiss	mortality	4 d	LC50	36000	EPA 1995
Pimephales promelas	growth	64 d	TC	≤ 1000	Call et al. 1987

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Chloridazon

5-amino-4-chloro-2-phenyl-3(2*H*)-pyridazinone
CAS Number: 1698-60-8

Quality Target

Protected Asset	Water (µg/l)
Aquatic Communities	10
Drinking Water Supply	0.1

1. General

Chloridazon is a selective herbicide from the diazine chemical family. It is mainly absorbed by the roots and moves upward in the plant through the xylem. Chloridazon inhibits photosynthesis. It is applied as a pre- and post-emergence herbicide, especially to control seed weed and grass weed in sugar beets, fodder beets, red beets, onions and mangel.
Pesticides containing the active ingredient chloridazon are authorized in Germany (BBA, 1998).

2. Aquatic Communities

Ecotoxicological results from longer-term tests are available for bacteria, algae, crustaceans and fish. The most sensitive test results are listed in section 4. The lowest value from longer-term tests was recorded for algae (Selenastrum capricornutum) with an EC10 of 118 µg/l.

The quality target for aquatic communities was derived by multiplying the EC10 of the most sensitive alga species by the compensation factor F1 = 0.1.
(QT = 118 µg/l x 0.1 = 11.8 µg/l, rounded 10 µg/l).

3. Drinking Water Supply

The maximum value of 0.1 µg/l determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is 0.1 µg/l.

4. Test Results

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Chloridazon							
1698-60-8							
Bacteria							
Pseudomonas putida	no data	1	d	NOEC		420000	PSM database 1988
Pseudomonas putida	no data	1	d	EC10		680000	PSM database 1988
Pseudomonas putida	no data	1	d	EC50		2000000	PSM database 1988
Algae							
Selenastrum capricornutum	biomass	5	d	EC50		340	EPA 1995
Selenastrum capricornutum	biomass	5	d	EC25		213	EPA 1995
Selenastrum capricornutum	biomass	3	d	EC10		118	EPA 1995
Navicula	no data	5	d	EC50		550	EPA 1995
Skeletonema costatum	no data	5	d	EC50		1030	EPA 1995
Chlorella fusca	growth	5	d	EC0		730	PSM database 1982
Chlorella fusca	growth	5	d	EC50		1900	PSM database 1982
Crustaceans							
Daphnia magna	reproduction	21	d	EC10		6230	PSM database 1989
Daphnia magna	reproduction	21	d	LOEC		7810	PSM database 1989
Daphnia magna	no data	21	d	NOEC		10000	PSM database 1994
Daphnia magna	no data	21	d	LOEC		20000	PSM database 1994
Daphnia magna	immobilization	21	d	EC0		31200	PSM database 1989
Daphnia magna	no data	2	d	NOEC		32000	PSM database 1977
Daphnia magna	no data	2	d	EC50		50100	PSM database 1977
Fish							
Oncorhynchus mykiss	growth	28	d	NOEC		3160	PSM database 1990
Oncorhynchus mykiss	no data	28	d	NOEC		10000	PSM database 1990
Blue-green algae							
Anabaena flos-aquae	no data	5	d	EC50		570	EPA 1995
Macrophytes							
Lemna gibba	no data	14	d	EC50	>	4600	EPA 1995

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Chlorotoluron

N'-(3-chloro-4-methylphenyl)-*N,N*-dimethylurea
CAS Number: 15545-48-9

Quality Target

Protected Asset	Water (µg/l)
Aquatic Communities	0.4
Drinking Water Supply	0.1

1. General

Chlorotoluron is a selective herbicide from the group of urea derivatives. It is absorbed through the roots and transported to the stems and leaves by transpiration flux. Only a small amount is absorbed through the leaves where the active ingredient moves to the leaf tips. Chlorotoluron inhibits photosynthesis (photosystem II). It is mainly used to control annual weed including some grass species. It is applied as a pre- and post-emergence herbicide on winter grain.
Pesticides containing the active ingredient chlorotoluron are authorized in Germany (BBA, 1998).

2. Aquatic Communities

Results from longer-term tests to assess the ecotoxicological effects are available for algae, crustaceans and fish. Only results from acute tests are available for bacteria. The most sensitive test results are listed in section 4. The lowest value from long-term tests was recorded for algae (Scenedesmus subspicatus) with an NOEC of 4 µg/l.
The quality target for aquatic communities was derived by multiplying the NOEC of the most sensitive alga species by the compensation factor F1 = 0.1.
(QT = 4 µg/l x 0.1 = 0.4 µg/l).

3. Drinking Water Supply

The maximum value of 0.1 µg/l determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is 0.1 µg/l.

4. Test Results

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Chlorotoluron 15545-48-9							
Bacteria							
Sewage sludge bacteria (aerobic)	respiration	3	h	EC50	>	100000	PSM database
Algae							
Chlorella pyrenoidosa	growth	4	d	NOEC		50	Anton et al. 1993
Scenedesmus subspicatus	biomass	3	d	EC10		4	PSM database
Scenedesmus subspicatus	growth	3	d	LOEC		10	BBA 1993
Chlorella fusca	growth	1	d	EC50		23	Faust et al. 1993
Scenedesmus subspicatus	growth	3	d	EC50		24	BBA 1993
Chlorella pyrenoidosa	growth	4	d	EC50	>	25.8	Anton et al. 1993
Chlorella pyrenoidosa	growth	4	d	NOEC		50	Anton et al. 1993
Chlorella pyrenoidosa	growth	4	d	EC50		100	Anton et al. 1993
Chlorella pyrenoidosa	growth	4	d	EC50	>	100	Anton et al. 1993
Crustaceans							
Daphnia magna	reproduction	21	d	NOEC		16670	BBA 1993
Daphnia magna	reproduction	21	d	LC100		30900	BBA 1993
Fish							
Oncorhynchus mykiss	growth	21	d	NOEC		400	BBA 1993
Oncorhynchus mykiss	no data	21	d	NOEC		410	PSM database
Oncorhynchus mykiss	no data	21	d	NOEC		440	PSM database
Oncorhynchus mykiss	growth	21	d	LOEC		1800	BBA 1993
Oncorhynchus mykiss	no data	21	d	LOEC		1960	PSM database
Oncorhynchus mykiss	growth	21	d	LC100		7000	BBA 1993
Oncorhynchus mykiss	mortality	4	d	LC50		35000	Bathe et al. 1972
Oncorhynchus mykiss	mortality	2	d	LC50		45000	Bathe et al. 1972

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The Science of the Total Environment, Supplement 1993 Elsevier Science Publishers B. V., Amsterdam, 941-952

PSM-Datenbank (PSM database),
Umweltbundesamt (Federal Environmental Agency), Berlin

2,4-D
(2,4-dichlorophenoxy)acetic acid
CAS Number: 94-75-7

Quality Target

Protected Asset	Water (µg/l)
Aquatic Communities	2.0
Drinking Water Supply	0.1

1. General

(2,4-dichlorophenoxy)acetic acid (2,4-D) is primarily used as a growth-regulating herbicide. In most cases it is applied in combination with other herbicides to control dicotyledonous weed in cereals and lawns. Pesticides containing the active ingredient 2,4-D are authorized in Germany to control dock species and dicotyledonous weed (BBA, 1998). Various 2,4-D salt and ester variants are also in use.

2. Aquatic Communities

Results from longer-term tests to assess the ecotoxicological effects are available for bacteria, algae, crustaceans, fish and other species groups. The most sensitive test results for 2,4-D including its salt and ester variants are listed in section 4. The test results of 2,4-D ester variants were not used to derive a quality target because they hydrolyze quickly into 2,4-D. However, the 2,4-D ester variants are more toxic to crustaceans and fish than 2,4-D itself. 2,4-D and its 2,4-D ester variants are almost equally toxic on algae and aquatic plants. A complete documentation of the extensive acute test results is not included in this publication.
Among the tested species, the most sensitive to 2,4-D are aquatic plants (Lemna perpusilla, 11 d, growth, EC10 = 20 µg/l and Myriophyllum spicatum, 5 d, growth, NOEC = 20 µg/l). In the case of 2,4-D butyl glycol ester, higher mortality rates were observed among the species Elodea candensis, Myriophyllum spicatum and Vallisneria americana, even at a concentration of 10 µg/l. Algae species proved to be significantly less sensitive than aquatic plants. In the case of plants, a combinatory effect can be expected whenever several active ingredients of phenoxycarboxylic acids are present in the water at the same time, due to the mode of action of that substance group.

Fish (salmonids) proved to be more sensitive to 2,4-D butyl ester, 2,4-D propylene glycol butyl ether ester and 2,4-D butyl glycol ester than they were to 2,4-dichlorophenoxyacetic acid. The NOEC for the most sensitive fish species (Oncorhynchus clarki, 60 d) was 24 µg/l for 2,4-D butyl ester.

The quality target for aquatic communities was derived by multiplying the EC10 of the aquatic plant Lemna perpuscilla by the compensation factor F1 = 0.1.
(QT = 20 µg/l x 0.1 = 2 µg/l). The quality target for the overall concentration of all 2,4-D variants and their conversion products (with regard to 2,4-D) is 2 µg/l.

3. Drinking Water Supply

The maximum value of 0.1 µg/l determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is 0.1 µg/l.

4. Test Results

Species	Effect	Time		Value	Conc. µg/l	Reference
2,4-D 94-75-7						
Bacteria						
Photobacterium phosphoreum	bioluminescence	5	min	EC50	100700	Somasundaram et al. 1990
Photobacterium phosphoreum	bioluminescence	15	min	EC50	5680	Kaiser & Palabrica 1991
Pseudomonas putida	cell multiplication	4	d	NOEC	105000	PSM database
Pseudomonas putida	cell multiplication	4	d	EC50	440000	PSM database
Algae						
Chlorella fusca	cell multiplication	1	d	EC50	88900	Faust et al. 1993
Polytoma uvella	cell multiplication	120	h	TC	2210	Pelekis et al. 1987
Polytomella papillata	cell multiplication	80	h	TC	2210	Pelekis et al. 1987
Scenedesmus quadricauda	cell multiplication	20	d	EC50	98000	Fargasova 1994
Selenastrum capricornutum	cell multiplication	5	d	NOEC	26400	PSM database
Selenastrum capricornutum	cell multiplication	5	d	EC25	29000	PSM database
Selenastrum capricornutum	cell multiplication	5	d	EC50	33000	PSM database
Aquatic plants						
Lemna minor	physiological effect	4	d	TC	200	O' Brien 1979
Lemna perpusilla	growth	11	d	TC	100	Schott & Worthly 1974
Lemna perpusilla	growth	11	d	EC50	120	PSM database, Schott & Worthly 1974
Lemna perpusilla	growth	11	d	EC10	20	PSM database Schott & Worthly 1974

Species	Effect	Time		Value		Conc. µg/l	Reference
2,4-D 94-75-7							
Myriophyllum brasiliense	growth	14	d	NOEC		221	Sutton & Bingham 1970
Myriophyllum brasiliense	growth	14	d	LOEC		553	Sutton & Bingham 1970
Myriophyllum spicatum	growth	5	d	NOEC		20	Christopher & Bird 1992
Myriophyllum spicatum	growth	5	d	LOEC		40	Christopher & Bird 1992
Myriophyllum spicatum	growth	5	d	EC50		40	Bird 1993
Myriophyllum spicatum	growth	11	w	NOEC	<	30	Westerdahl & Hall 1983
Potamogeton pectinatus	growth	11	w	NOEC		30	Westerdahl & Hall 1983
Potamogeton pectinatus	growth	11	w	LOEC		50	Westerdahl & Hall 1983
Crustaceans							
Daphnia magna	no data	21	d	NOEC		79000	PSM database
Daphnia magna	no data	21	d	LOEC		142000	PSM database
Daphnia magna	mortality	2	d	LC50		181300	Fargasova 1994
Daphnia magna	no data	21	d	EC50		235000	PSM database
Fish							
Cyprinus carpio	no data	4	d	NOEC		180000	PSM database
Oncorhynchus mykiss	no data	4	d	NOEC		100000	PSM database
Other Species and/or Parameters							
Worms							
Tubifex tubifex	mortality	4	d	LC50		161170	Fargasova 1994
2,4-D butyl ester 94-80-4							
Fish							
Oncorhynchus clarki	mortality	60	d	NOEC		24	Woodward & Mayer 1978
Oncorhynchus clarki	mortality	60	d	LOEC		44	Woodward & Mayer 1978
Salvelinus namaycush	mortality	60	d	NOEC		33	Woodward & Mayer 1978
Salvelinus namaycush	mortality	60	d	LOEC		60	Woodward & Mayer 1978

Species	Effect	Time	Value	Conc. µg/l	Reference
2,4-D butyl glycol ester 1929-73-3					
Aquatic plants					
Elodea canadensis	mortality	13 d	TC	10	Quinn et al. 1977
Myriophyllum spicatum	mortality	22 d	TC	10	Quinn et al. 1977
Vallisneria americana	mortality	39 d	TC	10	Quinn et al. 1977
Fish					
Oncorhynchus tshawytscha	growth	86 d	NOEC	40	Finlayson & Verrue 1985
Oncorhynchus tshawytscha	mortality	86 d	NOEC	40	Finlayson & Verrue 1985
Oncorhynchus tshawytscha	growth	86 d	LOEC	60	Finlayson & Verrue 1985
Oncorhynchus tshawytscha	mortality	86 d	LOEC	60	Finlayson & Verrue 1985
2,4-D dimethylamine salt 20940-37-8					
Algae					
Selenastrum capricornutum	no data	5 d	NOEC	19200	PSM database
Selenastrum capricornutum	no data	5 d	EC25	25900	PSM database
Selenastrum capricornutum	no data	5 d	EC50	66500	PSM database
Blue-green algae					
Anabaena flos-aquae	no data	5 d	EC25	38500	PSM database
Anabaena flos-aquae	no data	5 d	NOEC	67860	PSM database
Anabaena flos-aquae	no data	5 d	EC50	153000	PSM database
Aquatic plants					
Salvinia natans	physiological effect	28 d	NOEC	100	Göncz & Sencic 1994
Salvinia natans	physiological effect	28 d	EC50	300	Göncz & Sencic 1994
Salvinia natans	physiological effect	28 d	LOEC	1000	Göncz & Sencic 1994
Salvinia natans	growth	28 d	NOEC	1000	Göncz & Sencic 1994
Salvinia natans	growth	28 d	EC50	6000	Göncz & Sencic 1994
Salvinia natans	growth	28 d	LOEC	10000	Göncz & Sencic 1994

Species	Effect	Time		Value		Conc. µg/l	Reference
2,4-D dimethylamine salt							
20940-37-8							
Crustaceans							
Daphnia magna	no data	21	d	NOEC		27500	PSM database
Daphnia magna	no data	21	d	LOEC		59600	PSM database
Daphnia magna	no data	21	d	LC50		91200	PSM database
Daphnia magna	no data	2	d	LC50		184000	PSM database
Daphnia magna	no data	1	d	LC50		406000	PSM database
Fish							
Lepomis macrochirus	no data	4	d	LC50		524000	PSM database
Oncorhynchus mykiss	no data	21	d	NOEC		60000	PSM database
Oncorhynchus mykiss	no data	28	d	LC0		120000	PSM database
Oncorhynchus mykiss	no data	21	d	LOEC	>	120000	PSM database
Oncorhynchus mykiss	no data	4	d	LC50		250000	PSM database
Pimephales promelas	no data	4	d	LC50		344000	PSM database
2,4-D sodium salt							
2702-72-9							
Bacteria							
Mixed population	cell multiplication	4	h	EC50		540000	Kwasniewska et al. 1980
Fish							
Mugil cephalus	mortality	4	d	LC50		32000	Tag El-Din et al. 1981
2,4-D propylene glycol butyl ether ester							
1320-18-9							
Fish							
Oncorhynchus clarki	mortality	60	d	NOEC		31	Woodward & Mayer 1978
Oncorhynchus clarki	mortality	60	d	LOEC		60	Woodward & Mayer 1978
Salvelinus namaycush	mortality	60	d	LOEC		52	Woodward & Mayer 1978
Salvelinus namaycush	mortality	60	d	NOEC		100	Woodward & Mayer 1978

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U.S. Fish Wildl. Serv. Tech. Paper 97:1-6

Dichlorprop-P
(*R*)-2-(2,4-dichlorophenoxy)propanoic acid
CAS Number: 15165-67-0

Quality Target

Protected Asset	Water (µg/l)
Aquatic Communities	10
Drinking Water Supply	0.1

1. General

Dichlorprop is a selective herbicide from the group of phenoxycarboxylic acids (growth-regulating herbicides). Due to its asymmetrical carbon atom, dichlorprop exists as a mixture of two optically active forms of which only dichlorprop-P (the R form) is herbicidally very active. It is assumed that it disturbs the plant's growth-regulating balance by inhibiting synthesis, decomposition and the function of natural growth-regulating substances. The mode of absorption by the plant depends on whether the active ingredient is a salt or an ester. As a salt it is mainly absorbed through the roots, as an ester through the leaves and stems. Once in the plant, the substance moves from one cell to another cell as well as through the phloem and xylem.

Dichlorprop is mainly used to control cleavers, chickweed and knotweed species. In combination with other herbicides it is applied as a post-emergence herbicide in winter grain and spring corn. Only dichlorprop-P is still authorized in Germany (BBA, 1998). Alongside dichlorprop-P (acid) various salt and ester variants are in use.

2. Aquatic Communities

Results from longer-term tests to assess the ecotoxicological effects are available for bacteria, algae, higher aquatic plants, crustaceans and fish. The test results for dichlorprop including its salt and ester variants are listed in section 4. The test results for dichlorprop ester variants were not used to derive a quality target as they hydrolyze quickly into dichlorprop. Among the tested species, aquatic plants were the most sensitive to dichlorprop. The most sensitive species tested in the laboratory was duckweed (Lemna gibba, number of leaflets, 14 d, EC10 = 1500 µg/l dichlorprop-P DMA salt or 1260 µg/l dichlorprop-P, respectively). A microcosm test with dichlorprop-P potassium salt showed a lower value. When water milfoil (Myriophyllum spicatum) was tested with a concentration of 100 µg/l dichlorprop-P, its biomass was significantly reduced in the spring season that followed as compared to the controls and there were no young shoots. Approximately 9 months into the test which was started at a concentration of 100 µg/l, Myriophyllum spicatum began to recover. At the end of the test, the concentrations were approximately 15 µg/l or 40 µg/l, respectively, in the parallel compartments. Based on the microcosm test it can be expected that the NOEC for Myriophyllum spicatum at a longer-term exposure is $\leq$ 40 µg/l.

In the case of plants, a combinatory effect can be expected whenever several active ingredients of phenoxycarboxylic acids are present in the water at the same time, due to the mode of action of that substance group.

The quality target for aquatic communities was derived by multiplying the EC10 for duckweed (Lemna gibba EC10 = 1260 µg/l dichlorprop-P) by the compensation factors F1 = 0.1 and F2 = 0.1.
(QT = 1260 µg/l x 0.1 x 0.1 = 12.60 µg/l, rounded 10 µg/l).
The compensation factor F2 = 0.1 accounts for the fact that Myriophyllum spicatum proved to be comparatively more sensitive in a non-standardized microcosm field test. The quality target for the overall concentration of all dichlorprop variants and their conversion products (with regard to dichlorprop) is 10 µg/l.

3. Drinking Water Supply

The maximum value of 0.1 µg/l determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is 0.1 µg/l.

4. Test Results

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Dichlorprop							
120-36-5							
Bacteria							
Pseudomonas putida	no data	96	h	NOEC		100000	PSM database
Algae							
Chlorella pyrenoidosa	no data	96	h	EC0		35100	PSM database
Crustaceans							
Daphnia magna	no data	48	h	EC50		5400	U.S. EPA 1995
Daphnia magna	reproduction	21	d	NOEC	<	10000	PSM database
Fish							
Oncorhynchus mykiss	mortality	96	h	LC50		500	U.S. EPA 1995
Poecilia reticulata	mortality	96	h	LC50		2300000	PSM database

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Dichlorprop-P **(D-isomer)**							
Bacteria							
Pseudomonas spec.	no data	4	d	NOEC	>	2000000	PSM database
Algae							
Pseudokirchneriella	biomass	3	d	EC10		196000	PSM database
Pseudokirchneriella	biomass	3	d	EC50		676000	PSM database
Crustaceans							
Daphnia magna	reproduction	21	d	NOEC		100000	PSM database
Fish							
Lepomis macrochirus	lethality	4	d	NOEC		25000	PSM database
Lepomis macrochirus	lethality	4	d	LC50		100000	PSM database
Oncorhynchus mykiss	no data	28	d	NOEC		100000	PSM database
Oncorhynchus mykiss	no data	4	d	LC50	>	100000	PSM database
Dichlorprop DMA salt							
Crustaceans							
Daphnia magna	reproduction	21	d	NOEC		10000	PSM database
Fish							
Oncorhynchus mykiss	no data	21	d	NOEC		122000	PSM database
Dichlorprop-P DMA salt 104786-87-0							
Blue-green algae							
Anabaena flos-aquae	biomass, growth rate	5	d	NOEC		9500	PSM database
Aquatic plants							
Lemna gibba	number of leaflets	14	d	EC10		1500	PSM database
Dichlorprop-P potassium salt							
Aquatic plants							
Myriophylum spicatum	abundance	350	d	LOEC		100[a]	Huber et al. 1995

[a] refers to dichlorprop-P

Species	Effect	Time	Value	Conc. [µg/l]	Reference
Dichlorprop butoxyethyl ester					
Fish					
Oncorhynchus gorbuscha	mortality	96 h	LC50	600	Wan et al. 1990
Oncorhynchus tshawytscha	mortality	96 h	LC50	600	Wan et al. 1990
Dichlorprop isooctyl ester					
28631-35-8					
Crustaceans					
Daphnia magna	reproduction	21 d	NOEC	400	PSM database
Fish					
Oncorhynchus mykiss	no data	21 d	NOEC	400	PSM database

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Acute Toxicity to Juvenile Pacific Salmonids and Rainbow Trout of Butoxyethylesters of 2,4-D, 2,4-DP and Their Formulated Product: Weedone CB and Ist Carrier.
Bull. Environ. Contam. Toxicol. 45, 604-611

Dichlorvos
2,2-dichloroethenyl dimethyl phosphate
CAS Number: 62-73-7

Quality Target

Protected Asset	Water (µg/l)
Aquatic Communities	0.0006
Drinking Water Supply	0.1

1. General

Dichlorvos is an insecticide and acaricide from the group of phosphoric acid esters. It is a respiratory and contact poison that inhibits acetylcholine esterase. Due to its high volatility the permanent effect is limited, yet it may be applied shortly before harvest and to control indoor hygienic pests and store pests. When applied in the field the permanent effect can be improved by using special additives or a combination with other active ingredients.
Pesticides containing the active ingredient dichlorvos are authorized in Germany (BBA, 1998).

2. Aquatic Communities

Results from longer-term tests to assess the ecotoxicological effects are available for algae, crustaceans and fish. For bacteria only results from acute tests are available. The test results are listed in section 4. The lowest value was recorded for crustaceans (Daphnia magna) with an NOEC of 0.006 µg/l. The active ingredient is also toxic to insects.

The quality target for aquatic communities was derived by multiplying the lowest value for crustaceans by the compensation factor F1 = 0.1.
(QT = 0.006 µg/l x 0.1 = 0.0006 µg/l). The quality target for dichlorvos is 0.0006 µg/l.

3. Drinking Water Supply

The maximum value of 0.1 µg/l determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is 0.1 µg/l.

4. Test Results

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Dichlorvos 62-73-7							
Bacteria	no data	20	min	EC50		202800	Amann 1989
Algae							
Plankton	cell multiplication	90	d	TC	<	14	Pal & Konar 1985
Plankton	^{14}C fixation	4	h	NOEC	≥	500	Raine et al. 1990
Plankton	^{14}C fixation	4	h	LOEC	≤	1000	Raine et al. 1990
Scenedesmus subspicatus	no data	4	d	NOEC		18000	PSM database 1985
Scenedesmus subspicatus	no data	4	d	LOEC		32000	PSM database 1985
Scenedesmus subspicatus	no data	4	d	EbC50		52800	PSM database 1985
Scenedesmus subspicatus	no data	4	d	ErC50		159600	PSM database 1985
Crustaceans							
Daphnia magna	reproduction	21	d	NOEC		0.006	Bruns & Knacker 1998
Daphnia magna	no data	2	d	NOEC		0.056	PSM database 1985
Daphnia pulex	no data	2	d	EC50		0.07	U.S. EPA 1995
Daphnia magna	no data	2	d	EC50		0.19	PSM database 1985
Marine crustaceans							
Homarus gammarus L.	mortality	23	d	NOEC		0.63	Mc Henery et al. 1996
Fish							
Tilapia mossambica	growth	90	d	LOEC		14	Pal & Konar 1985
Cyprinus carpio	growth	60	d	MATC	≥	16	Verma et al. 1981
Cirrhinus mrigala	mortality	60	d	MATC	>	18.1	Verma et al. 1984
Cirrhinus mrigala	mortality	60	d	MATC	<	21.3	Verma et al. 1984
Cirrhinus mrigala	mortality	4	d	LC50		290	Verma et al. 1984
Oncorhynchus mykiss	no data	1	d	LC50		500	PSM database

Species	Effect	Time	Value	Conc. [µg/l]	Reference
Worms					
Branchiura sowerbyi	mortality		LC5	32	Pal 1983
Branchiura sowerbyi	mortality		LC50	71	Pal 1983
Branchiura sowerbyi	mortality		LC95	109	Pal 1983
Shells					
Anodonta cygnea	behaviour	5 d	TC	9.9	Varanka 1987
Insects					
Pteronarcys californica	mortality	4 d	LC50	0.1	Johnson & Finley 1980

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Acta hydrochim. hydrobiol., 9 (3), 247-254

Dimethoate
CAS Number: 60-51-5

Quality Target

Protected Asset	Water (µg/l)
Aquatic Communities	0.2
Drinking Water Supply	0.1

1. General

Dimethoate is an insecticide to control biting and sucking insects and is used as a molluscicide, e.g. to control Bilharzia. Dimethoxon is a metabolizing product for which no ecotoxicological data are included in this publication.
Pesticides containing the active ingredient dimethoate are authorized in Germany (BBA, 1998).

2. Aquatic Communities

NOEC data or similar subchronic and chronic results from longer-term tests to assess the ecotoxicological effects are available for algae, crustaceans and fish. No data are available for bacteria. The derivation of a quality target to protect aquatic communities is based on the assumption that bacteria do not represent the most sensitive species group.

Molluscs were the most sensitive among the tested species. However, as molluscs are not among the routinely tested organisms according to the concept of the federal government/federal states working group, they are taken into account only by applying the compensation factor F2 to the derivation of a quality target.

The normal case quality target was derived by multiplying the NOEC (23 d) for Daphnia magna (23 µg/l) by the compensation factor 0.1. The fact that the substance is significantly more toxic to molluscs is accounted for by applying the compensation factor F2 = 0.1. (QT = 23µg/l x 0.1 x 0.1 = 0.23 µg/l, rounded 0.2 µg/l). The quality target for dimethoate is 0.2 µg/l.

3. Drinking Water Supply

The maximum value of 0.1 µg/l determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is 0.1 µg/l.

4. Test Results

Species	Effect	Time		Value	Conc. [µg/l]	Reference
Dimethoate						
60-51-5						
Algae						
Amphiprora paludosa	chlorophyll content	4	d	EC 50	10.5	Ibrahim 1983
Phaeodactylum tricornutum	chlorophyll content	4	d	EC 50	10.5	Ibrahim 1983
Skeletonema costatum	chlorophyll content	4	d	EC 50	11	Ibrahim 1983
Chlamydomonas reinhardtii	growth	8	d		1000-40000	Wong & Chang 1988
Selenastrum capricornutum	growth inhibition	3	d	EC 10	12680	PSM database
Selenastrum capricornutum	growth inhibition	3	d	NOEC	30400	PSM database
Crustaceans						
Carcinus maenas	mortality	2	d	LC 50	0.3	Portmann & Wilson 1971
Crangon crangon	mortality	2	d	LC 50	0.3	Portmann & Wilson 1971
Cyclops strenuus	mortality	4	d	LC 50	2.0	Abul-Ela & Khalil 1987b
Daphnia longispina	mortality	4	d	LC 50	2.6	Aboul-Ela & Khalil 1987b
Daphnia magna	mortality	20	d	NTEL	32	Canton et al. 1980
Daphnia magna	reproduction	20	d	NTEL	100	Canton et al. 1980
Daphnia magna	reproduction	21	d		100	Slooff & Canton 1983
Daphnia magna	growth	16	d	EC 10	210	Deneer et al.1988
Daphnia magna		23	d	NOEC	23	Beusen & Neven 1989
Daphnia magna	reproduction	21	d	NOEC	100	Slooff & Canton,1983
Daphnia magna	immobilization	2	d	EC 50	3500	PSM database
Daphnia magna	reproduction	21	d	LOEC	100	PSM database
Daphnia magna	reproduction	21	d	MAT C	63	PSM database
Daphnia magna	reproduction	21	d	NOEC	40	PSM database
Gammarus lacustris	mortality	4	d	LC 50	200	Johnson & Finley,1980
Fish						
Barbus conchonis	histology	15	d		434	Gill et al. 1988
Barbus conchonis	mortality	4	d	LC 50	4784	Pant & Singh,1983

Species	Effect	Time		Value	Conc. [µg/l]	Reference
Channa punctatus	biochemical	35	d		410	Ghosh 1987
Oncorhynchus mykiss	growth	21	d	LOEC	2000	PSM database 1990
	growth	21	d	NOEC	400	PSM database 1990
Oryzias latipes (eggs)	mortality	40	d		320	Slooff & Canton 1983
Cyprinus carpio	mortality	1-1.25	d		1000	Kulshrestha & Arora 1986
Lepomis macrochirus	mortality	4	d	LC 50	6000	Johnson & Finley 1980
Tilapia mossambica	reproduction	7	d		1200	Manna & Sadhukhan 1986
Other Species and/or Parameters						
Amphibians						
Rana hexadactyla	mortality	12	h	LC 50	8.12	Khangarot et al. 1985
Rana hexadactyla	mortality	4	d	LC 50	7.82	Khangarot et al. 1985
Xenopus laevis	mortality	100	d		1000	Slooff & Canton 1983
Insects						
Chironomidae	mortality	1	d	LC 50	40.20	Joshi et al. 1975
Pteronarcys californica	mortality	4	d	LC 50	43	Sanders & Cope 1968
Culex pipiens		25	d		320	Slooff & Canton 1983
Cochlea						
Heliosoma trivolvis	reproduction	7-63	d	EC	0.0075	Aboul-Ela & Khalil 1987a
	probit analysis:					
	fecundity	63	d	EC 50	0.058	
	(cumulative)	63	d	EC 50	0.12	
	fecundity (3rd week)	63	d	EC 50	0.16	
	shell growth					
Lymnaea acuminata		2	d	LC 50	24.5	Chaudhari et al. 1988

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Diuron
CAS Number: 330-54-1

Quality Target

Protected Asset	Water (µg/l)
Aquatic Communities	0.05
Drinking Water Supply	0.1

1. General

Diuron is a member of the chlorinated urea compounds. It is used as a selective herbicide (also in combination with other herbicides) in fruit and vegetable farming and as a non-selective herbicide to control weed on surfaces in non-agricultural uses. Diuron is absorbed through the roots and inhibits plant photosynthesis. Pesticides containing the active ingredient diuron are authorized in Germany (BBA, 1998).

2. Aquatic Communities

Results from longer-term tests to assess the ecotoxicological effects are available for bacteria, algae, crustaceans, fish and other species groups. The most sensitive among the tested species were algae (Scenedesmus subspicatus, cell multiplication, 96 h, NOEC = 0.46 µg/l).

The quality target for aquatic communities was derived by multiplying the NOEC of the most sensitive alga species by the compensation factor F1 = 0.1.
(QT = 0.46 µg/l x 0.1 = 0.046 µg/l, rounded QT = 0.05 µg/l).

3. Drinking Water Supply

The maximum value of 0.1 µg/l determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is 0.1 µg/l.

4. Test Results

4.1 Aquatic Toxicity

Species	Effect	Time	Value	Conc. [µg/l]	Reference
Diuron 330-54-1					
Bacteria					
Bacillus thuringiensis	cell multiplication	4 h	EC30	900	Süssmuth et al. 1992
Photobacterium phosphoreum	bioluminescence	5 min	EC 50	16380	McFeters et al. 1983
Algae					
Chlamydomonas moewusii	cell multiplication	7 d	EC50	2.4 uM 559	Cain & Cain 1983
Scenedesmus quadricauda	cell multiplication	7 d	EC1	5.3	Bringmann & Kühn 1974
Scenedesmus subspicatus	cell multiplication	3 d	EC10	0.056	PSM database
Scenedesmus subspicatus	cell multiplication	3 d	EC50	1	PSM database
Scenedesmus subspicatus	cell multiplication	4 d	NOEC	0.8 (nom.) 0 46 (meas.)	PSM database
Scenedesmus subspicatus	cell multiplication	4 d	LOEC	2.6	PSM database
Scenedesmus subspicatus	cell multiplication	4 d	ErC50	24	PSM database
Scenedesmus subspicatus	cell multiplication	4 d	EbC50	3	PSM database
Scenedesmus subspicatus	cell multiplication	3 d	NOEC	10	Schäfer et al. 1994
Scenedesmus subspicatus	cell multiplication	3 d	EC50	36	Schäfer et al. 1994
Scenedesmus subspicatus	cell multiplication	1 d	NOEC	7	Schäfer et al. 1994
Selenastrum capricornutum		5 d	EC50	22	Debourg et al. 1993
Blue-green algae					
Microcystis aeruginosa	cell multiplication	7 d	EC1	1.1	Bringmann & Kühn 1975
Nostec sepc.	cell multiplication	7d	EC1	10.8	Bringmann & Kühn 1975
Fish					
Lepomis macochirus	mortality	4 d	LC50	5900	Macek et al. 1969
Morone saxatilis	mortality	4 d	LC50	500	Hughes. 1973

Species	Effect	Time		Value	Conc. [µg/l]	Reference
Oncorhynchus clarki	mortality	4	d	LC50	1400	Johnson & Finley 1980
Oncorhynchus mykiss	mortality	4	d	LC50	4900	Johnson & Finley 1980
Oncorhynchus mykiss	mortality	4	d	LC50	5600	Datenbank zur Toxikologie der Herbizide
Oncorhynchus mykiss	mortality	4	d	NOEC	1000	PSM database
Oncorhynchus mykiss	mortality	4	d	LC50	14700	PSM database
Oncorhynchus mykiss	mortality	4	d	LLC	2150	PSM database
Oncorhynchus mykiss	mortality	28	d	LC50	4010	PSM database
Oncorhynchus mykiss	no data	28	d	NOEC	410	PSM database
Oncorhynchus mykiss	no data	28	d	LOEC	790	PSM database
Oncorhynchus mykiss	mortality	21	d	LLC	1880	PSM database
Oncorhynchus mykiss	mortality	21	d	LC50	3130	PSM database
Oncorhynchus mykiss	no data	21	d	NOEC	350	PSM database
Oncorhynchus mykiss	no data	21	d	LOEC	770	PSM database
Pimephales promelas	mortality	4	d	LC50	14200	Call et al. 1987
Pimephales promelas	mortality	8	d	LC50	7700	Call et al. 1987
Pimephales promelas	reproduction	64	d	NOEC	33.4	Call et al. 1987
Pimephales promelas	reproduction	64	d	LOEC	78	Call et al. 1987
Poecilia reticulata	mortality	4	d	LC50	25000	Datenbank zur Toxikologie der Herbizide
Tilapia mossambica	behaviour	90	d	NOEC	220	Reddy et al. 1992
Tilapia mossambica	behaviour	90	d	TC	550	Reddy et al. 1992
Tilapia mossambica	haemogram	90	d	TC	550	Reddy et al. 1992
Crustaceans						
Ceriodaphnia quadrangula	growth and reproduction	30-50	d		50-250	Shcherban 1972
Daphnia magna	growth and reproduction	30-50	d		50-250	Shcherban 1972
Daphnia magna		26	h	EC50	47000	IRPTC 1989
Daphnia magna	reproduction	21	d	LOEC	100	PSM database
Daphnia magna	reproduction	21	d	NOEC	56	PSM database
Daphnia pulex	mortality	4	d	LC50	1400	Johnson & Finley 1980
Daphnia pulex		2	d	EC50	1400	IRPTC 1989
Daphnia simocephalus		2	d	EC50	2000	IRPTC 1989
Gammarus fasciatus	mortality	4	d	LC50	160	Johnson & Finley 1980
Gammarus lacustris	mortality	4	d	LC50	160	Sanders 1969

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Other Species and/or Parameters							
Amphibians							
Bullfrog tadpole	mortality	4	d	LC50		3100	IRPTC 1989
Insects							
Chironomidae						40	Korostylev 1977
Chironomus riparius	hatching	24	d	EC0		100	PSM database
Chironomus riparius	no data	41	d	EC0		4000000	PSM database
Peteronarcys california	mortality	4	d	LC50		1200	IRPTC 1989
Macrophytes							
Lemna perpusilla	growth	7	d	EC50		15	Liu et al. 1974
Spirodela polyrhiza	growth	7	d	EC50		41	Liu et al. 1974
Molluscs							
E. oyster	shell growth	4	d			1800	IRPTC 1989
Mercenaria mercenaria	mortality, larvae	12	d	LC50	>	5000	IRPTC 1989
Mercenaria mercenaria	mortality, egg	2	d	LC50		2530	IRPTC 1989
Periphyton							
Multispecies	species diversity	3	w	TC		1.8648	Molander & Blanck 1992
Multispecies	assimilation	3	w	TC	≥	0.9324	Molander & Blanck 1992
Multispecies	photosynthesis	60	min	EC50		4.70862	Molander & Blanck 1992
Multispecies	photosynthesis	60	min	TC	≤	0.74592	Molander & Blanck 1992
Multispecies	photosynthesis	3	w	TC		4.662	Molander & Blanck 1992
Multispecies	tolerance	3	w	PICT	≥	9.324	Molander & Blanck 1992

4.2 Bioaccumulation

Species	Time		Test	Value	Reference
Pimephales promelas	24.0	d	BCF	2.0	Call et al. 1987

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Endosulfan
CAS Number: 115-29-7

Quality Target

Protected Asset	Water (µg/l)
Aquatic Communities	0.005
Drinking Water Supply	0.1

1. General

Endosulfan is a sulphuric acid ester of a chlorinated diol and has a neurotoxic effect. It is used to control biting and sucking insects in farming and against bugs, caterpillars, leaf lice and psocids in forests. Its main application is to control maybugs. Endosulfan is suspected to affect the reproductive capability and the endocrine system (see *UBA-Texte 65/95*). Pesticides containing the active ingredient endosulfan are not authorized in Germany (BBA, 1998).

2. Aquatic Communities

NOEC values from longer-term tests to assess the ecotoxicological effects are available for algae, crustaceans and fish. Only data from acute tests are available for bacteria. The most sensitive among the tested species were fish. The quality target for aquatic communities was derived by multiplying the NOEC (21 d) for Oncorhynchus mykiss by the compensation factor F1 = 0.1.
(QT = 0.05 x 0.1 = 0.005 µg/l). The quality target for endosulfan is 0.005 µg/l.

3. Drinking Water Supply

The maximum value of 0.1 µg/l determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is 0.1 µg/l.

4. Test Results

4.1 Aquatic Toxicity

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Endosulfan 115-29-7							
Bacteria							
Mixed population (natural Rhine water bacteria cenosis)	inhibition of bacterial ^{14}C glucose uptake	60	min	EC 10		1400	Matthias 1990
Mixed population (natural Rhine water bacteria cenosis)	inhibition of bacterial ^{14}C glucose uptake	60	min	EC 50		8500	Matthias 1990
Photobacterium phosphoreum	inhibition of light emission	30	min	EC 10		1200	Matthias 1990
Photobacterium phosphoreum	inhibition of light emission	30	min	EC 50		2900	Matthias 1990
Pseudomomas putida	O_2 consumption	30	min	EC10	>	300	Knie et al. 1983
Algae							
Chlorella vulgaris	cell multiplication	5	d	NOEC		10	Knauf et al. 1973
Haematococcus pluvialis	inhibition of O_2 production	4	h	EC 10	>	800	Knie et al. 1983
Scenedesmus subspicatus	growth	3	d	EC 50		>560 <1000	PSM database
Crustaceans							
Acartia tonsa	mortality	4	d	LC 50		0.03	Schimmel 1981 A
Alonella sp.	mortality (mixed population)	2	d	LC 50		0.2	Naqvi & Hawkins 1989
Cypria sp.	mortality (mixed population)	2	d	LC 50		0.9	Naqvi & Hawkins 1989
Daphnia carinata	no data	2	d	EC 50		180	PSM database
Daphnia carinata	no data	1	d	EC 50		500	PSM database
Daphnia longispina	mortality	2	d	LC 50		0.3	Magadza 1983
Daphnia longispina	mortality	1	d	LC 50		0.4	Magadza 1983
Daphnia magna	mortality	64	d	NOEC	>	2.7 < 7.0	Macek et al. 1976
Daphnia magna	reproduction	21	d	NOEC		10	Matthias 1990
Daphnia magna	no data	2	d	EC 50		0.47	PSM database
Daphnia magna	no data	1	d	EC 50		2.03	PSM database
Daphnia magna		1	d	EC 50		240	Frear & Boyd 1967
Daphnia magna	reproduction, immobilization	21	d	NOEC		20	PSM database

Species	Effect	Time	Value	Conc. [µg/l]	Reference
Daphnia magna	reproduction, immobilization	21 d	NOEC	63	PSM database
Daphnia magna	no data	21 d	LC 50	300	PSM database
Diaptomus sp.	mortality (mixed population)	2 d	LC 50	0.6	Naqvi & Hawkins 1989
Eucyclops sp.	mortality (mixed population)	2 d	LC 50	0.1	Naqvi & Hawkins 1989
Gammarus roeselii	immobilization	3 d	EC 0	0.5	Matthias 1990
Gammarus roeselii	immobilization	3 d	EC 50	9.8	Matthias 1990
Palaemonetes pugio	mortality	4 d	NOEC	0.032	Moore 1989
Penaeus duorarum	mortality	4 d	LC 50	0.04	Schimmel et al. 1977
Fish					
Carassius auratus	mortality	2 d	LC 50	0.1	Hashimoto & Nishiuchi 1981
Catostomus commersoni	mortality	4 d	LC 50	3.0	Schoettger 1970
Catostomus commersoni	mortality	4 d	LC 50	3.5	Schoettger 1970
Catostomus commersoni	mortality	5 d	LC 50	2.5	Schoettger 1970
Channa punctatus	mortality	4 d	LC 50	0.16	PSM database
Cyprinus carpio	mortality	4 d	LC 50	0.1	Sunderam et al. 1992
Heteropneustes fossilis	mortality	4 d	LC 50	2.0	Singh & Srivastava 1982
Heteropneustes fossilis	mortality	3 d	LC 50	2.5	Singh & Srivastava 1982
Heteropneustes fossilis	mortality	2 d	LC 50	2.9	Singh & Srivastava 1982
Heteropneustes fossilis	mortality	1 d	LC 50	3.3	Singh & Srivastava 1982
Labeo rohita	mortality	4 d	LC 50	1.1	Rao et al. 1980
Lepomis macrochirus (pond test, USA)	no data	210 d	NOEC	1.3	PSM database
Lepomis macrochirus	mortality	1 d	LC 50	2.7	PSM database
Morone saxatilis	mortality	4 d	LC 50	0.048	Korn & Russel 1974
Mystus vittatus	mortality	4 d	LC 50	0.79	Verma et al. 1981
Mystus vittatus	mortality	3 d	LC 50	0.9	Verma et al. 1981
Mystus vittatus	mortality	2 d	LC 50	1.4	Verma et al. 1981
Mystus vittatus	mortality	1 d	LC 50	1.9	Verma et al. 1981
Oncorhynchus mykiss	no data	21 d	NOEC	0.05	PSM database
Oncorhynchus mykiss	mortality	21 d	LC 50	0.283	PSM database
Oncorhynchus mykiss	mortality	4 d	LC 50	0.7	Sunderam et al. 1992
Oncorhynchus mykiss	mortality (flow-through system, 12 single tests)	4 d	LC 50	0.17-0.75	Lemke 1980
Oncorhynchus mykiss	mortality (static system, 12 single tests)	4 d	LC 50	0.49-2.43	Lemke 1980
Oncorhynchus mykiss	mortality	5 d	LC 50	0.3	Schoettger 1970

Species	Effect	Time	Value	Conc. [µg/l]	Reference
Oncorhynchus mykiss	mortality	4 d	LC 50	0.8	Schoettger 1970
Oncorhynchus mykiss	mortality	4 d	LC 50	0.3	PSM database
Oncorhynchus mykiss	mortality	4 d	LC 5	0.61	PSM database
Oncorhynchus mykiss	mortality	4 d	LC 50	0.93	PSM database
Oncorhynchus mykiss	mortality	4 d	LC 95	1.42	PSM database
Oncorhynchus mykiss	mortality	2 d	LC 50	1.6	PSM database
Oncorhynchus mykiss	mortality	1 d	LC 50	3.67	PSM database
Oncorhynchus mykiss	no data	4 d	LC 50	1.7	PSM database
Oncorhynchus mykiss	mortality	1 d	LC 50	1.8	PSM database
Ophiocephalus punctatus	mortality	4 d	LC 50	21	Verma et al. 1981
Ophiocephalus punctatus	mortality	3 d	LC 50	26	Verma et al. 1981
Ophiocephalus punctatus	mortality	2 d	LC 50	31	Verma et al. 1981
Ophiocephalus punctatus	mortality	1 d	LC 50	37	Verma et al. 1981
Pimephales promelas	no data	60 d	NOEC	0.2	PSM database
Pimephales promelas	no data	360 d	NOEC	0.2	PSM database
Pimephales promelas	mortality	60 d	NOEC	> 0.2 < 0.4	Macek et al. 1976
Pimephales promelas	mortality	7 d	LC 50	0.86	Macek et al. 1976
Pimephales promelas	mortality (flow-through system, 12 single tests)	4 d	LC 50	0.29-1.91	Lemke 1980
Pimephales promelas	mortality (static system, 12 single tests)	4 d	LC 50	0.97-3.45	Lemke 1980
Pimephales promelas	no data	4 d	LC 50	1.3	PSM database
Tilapia mossambicus	mortality	4 d	LC 50	0.06	Matthiessen & Logan 1984
Tilapia mossambicus	mortality	2 d	LC 50	0.2	Matthiessen & Logan 1984
Tilapia mossambicus	mortality	1 d	LC 50	0.5	Matthiessen & Logan 1984

Other Species and/or Parameters

Fish

Tilapia mossambicus (juvenile)	reproduction behaviour	28 d	NOEC	> 0.2 < 0.5	Matthiessen & Logan 1984
Channa punctatus (14.54 cm)	chemical composition of scales	5, 15 d	TC	≤ 2.2-3.5	Johal & Dua 1995
Tandanus tandanus (20.9-42.9 cm, from field study)	histological alteration of gills	1 d	TC	1.0	Nowak 1992

4.2 Bioaccumulation

Species	Effect	Time	Test	Value	Reference
Fish					
Brachydanio rerio	residue	21 d	BCF	2006-2650	Toledo & Jonsson 1992
Hyphessobrycon bifasciatus	residue	21 d	BCF	9908-11583	De la Cruz & Yarbrough 1982

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Etrimphos

CAS Number: 38260-54-7

Quality Target

Protected Asset	Water (µg/l)
Aquatic Communities	0.004
Drinking Water Supply	0.1

1. General

Etrimphos is a non-systemic insecticide and acts as a stomach and contact poison. It is applied on vegetables, fruit, ornamental plants and arable land. Only few tests have been conducted to estimate the effect of etrimphos on aquatic communities. Pesticides containing the active ingredient etrimphos are not authorized in Germany (BBA, 1998).

2. Aquatic Communities

NOEC data from longer-term tests to assess the ecotoxicological effects are available for bacteria, algae, crustaceans and fish. The most sensitive among the tested species were crustaceans. The quality target for aquatic communities was derived by multiplying the NOEC (21 d) for Daphnia magna (Batelle Europe, 91) by the compensation factor F1 = 0.1. (QT = 0.04 x 0.1 = 0.004). The quality target for etrimphos is 0.004 µg/l.

3. Drinking Water Supply

The maximum value of 0.1 µg/l determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is 0.1 µg/l.

4. Test Results

4.1 Aquatic Toxicity

Species	Effect	Time		Value	Conc. [µg/l]	Reference
Etrimphos 38260-54-7						
Bacteria						
Photobacterium phosphoreum	bioluminescence	30	min	EC 10	2500	Matthias 1990
Photobacterium phosphoreum	bioluminescence	30	min	EC 50	18500	Matthias 1990
Rhine water bacteria cenosis	^{14}C glucose uptake	60	min	EC 10	2400	Matthias 1990
Rhine water bacteria cenosis	^{14}C glucose uptake	60	min	EC 50	21200	Matthias 1990
Algae						
Scenedesmus subspicatus	O_2 production	3	d	EC 10	900	Matthias 1990
Scenedesmus subspicatus	cell multiplication	4	d	EC 50	2900	PSM database
Scenedesmus subspicatus	O_2 production	3	d	EC 50	7300	Matthias 1990
Crustaceans						
Daphnia magna	mortality, reproduction	21	d	NOEC	0.04	Batelle Europe, Final Report 2/91
Daphnia magna	mortality, reproduction	21	d	LOEC	0.4	Batelle Europe, Final Report 2/91
Daphnia magna	immobilization	2	d	EC 0	20	Batelle Europe, Final Report
Daphnia magna	immobilization	2	d	EC 50	17.3	Batelle Europe, Final Report
Daphnia magna	immobilization	2	d	EC 100	50	Batelle Europe, Final Report
Daphnia magna	reproduction	21	d	NOEC	0.05	Matthias 1990
Daphnia magna	immobilization	3	d	EC 50	2.0	Matthias 1990
Gammarus roeseli	immobilization	3	d	EC 50	6.2	Matthias 1990
Fish						
Salmo gairdneri	mortality, behaviour	16	d	NOEC	8.5	Batelle Europe, Final Report
Salmo gairdneri	mortality, behaviour	16	d	LOEC	22	Batelle Europe, Final Report
Salmo gairdneri	mortality, behaviour	16	d	LC 50	32	Batelle Europe, Final Report
Leuciscus idus	mortality	4	d	EC 0	5000	Matthias 1990
Leuciscus idus	mortality	4	d	EC 50	6000	Matthias 1990

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PSM-Datenbank (PSM database),
Umweltbundesamt (Federal Environmental Agency), Berlin

Fenitrothion
CAS Number: 122-14-5

Quality Target

Protected Asset	Water (µg/l)
Aquatic Communities	0.009
Drinking Water Supply	0.1

1. General

Fenitrothion is a toxic organophosphorus ester used in farming and to control insects (spruce worm) in forests. It is also applied in public health programs to control flies, midges and cockroaches. Fenitrothion inhibits acetylcholine esterase. Pesticides containing the active ingredient fenitrothion are not authorized in Germany (BBA, 1998).

2. Aquatic Communities

NOEC data or similar sublethal results from longer-term tests to assess the ecotoxicological effects are available for algae, crustaceans and fish. Only data from acute tests are available for bacteria. Crustaceans were the most sensitive among the tested organisms. The quality target was derived by multiplying the lowest NOEC for crustaceans (Daphnia magna: 0.087 µg/l) by the compensation factor F1 = 0.1.
(QT = 0.087 µg/l x 0.1 = 0.0087 µg/l, rounded 0.009 µg/l). The quality target for fenitrothion is 0.009 µg/l.

3. Drinking Water Supply

The maximum value of 0.1 µg/l determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is 0.1 µg/l.

4. Test Results

4.1 Aquatic Toxicity

Species	Effect	Time		Value	Conc. [µg/l]	Reference
Fenitrothion 122-14-5						
Bacteria						
Mixed population	growth	4	h	EC 50	450000	Kwasniewska 1980
Algae						
Algae		4	d	EC 50	3900	Canton 1990
Anabaena sp.	cell multiplication	4	d	EC 50	1100	Kent & Curie 1995
Ankistrodesmus falcatus	cell multiplication	14	d	NOEC	100	Kent & Curie 1995
Ankistrodesmus falcatus	cell multiplication	4	d	EC 50	2500	Kent & Curie 1995
Chlamydomonas reinhardtii	cell multiplication	14	d	LOEC	100	Kent & Curie 1995
Chlamydomonas reinhardtii	cell multiplication	4	d	EC 50	4800	Kent & Curie 1995
Chlamydomonas segnis.	cell multiplication	4	d	EC 50	2800	Kent & Curie 1995
Chlorella vulgaris		7	d	EC 100	> 1 00 000	Kikuchi 1984
Chlorella vulgaris	cell multiplication	4	d	EC 50	24400	Kent & Curie 1995
Navicula sp.	cell multiplication	4	d	EC 50	3500	Kent & Curie 1995
Scenedesmus obliquus	cell multiplication	4	d	EC 50	6400	Kent & Curie 1995
Selenastrum capricornutum	cell multiplication	4	d	EC 50	5020	Kent & Curie 1995
Crustaceans						
Astacopsis gouldi	mortality	7	d	LC 50	0.7	Davies et al. 1994
Alitropus typus	mortality	2	d	LC 50	1.9[1]	Nair & Nair 1982
Caridina rajadhari	mortality	4	d	LC 50	0.021	Pawar & Katdare 1983
Cyclops vernalis	mortality	1	d	LC 50	0.8	Muller 1970
Cyclops vernalis	mortality	1	d	LC 90	80	Muller 1970
Daphnia magna	mortality	21	d	NOEC	0.087	US-EPA 1995
Daphnia magna	mortality	21	d	LOEC	0.23	US-EPA 1995
Daphnia pulex	immobilization	1	d	EC 50	1.6	Takimoto et al. 1987
Daphnia pulex	mortality	6	h	LC 50	7.0	Hashimoto et al. 1981
Gammarus fasciatus	mortality	1	d	EC50	3	Johnson & Finley 1980
Macrobrachium kistnensis	mortality	4	d	LC 50	0.92	Pawar & Katdare 1983

[1] converted to 100 % active ingredient

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Macrobrachium lamerrii	mortality	20	d	LC 100		0.1	Sarojini et al. 1986
Macrobrachium lamerrii	mortality	4	d	LC 50		0.1	Sarojini et al. 1986
Palaemon paucidens	mortality	4	d	LC 50		2.2	Takimoto et al. 1987
Paratya australiensis	mortality	7	d	LC 50		0.7	Davies et al. 1994
Fish							
Anguilla anguilla		4	d	LC 50		200	Ferrando et al. 1987
Cyprinus carpio	hatching rate	55-74	h	LC 50		620	Knaur & Toor 1977
Galaxis maculatus	mortality	10	d	LC 50	>	220	Davies et al. 1994
Gambusia affinis	mortality	4	d	LC 50		1.7	Patwardhan & Gaikwad 1991
Oncorhynchus mykiss	mortality	10	d	LC 50	>	220	Davies et al. 1994
Pimephales promelas	biomass	31	d	LOEC		300	Kleiner et al. 1984
Pimephales promelas	mortality	31	d	NOEC		≥ 300 < 740	Kleiner et al. 1984
Poecilia reticulata	reproduction	60	d	LOEC		250	Yasuno 1980
Pseudaphritis urvillii	mortality	10	d	LC 50	>	220	Davies et al. 1994
Salmon salar (juvenile)	mortality	4	d	LC 50		1.6	Morgan & Kiceniuk 1990
Salmo gairdneri (early life-stage test)	growth (biomass, length)			NOEC		46	US-EPA 1995
Salmo gairdneri (early life-stage test)	growth (biomass, length)			LOEC		88	US-EPA 1995
Other Species and/or Parameters							
Amphibians							
Ambystoma maculatum Larvae	immobilization	1	d	TC		5000	Berrill et al. 1995
Buffo amercanus Tadpole, 0.5-1 cm	immobilization	1	d	TC		5000	Berrill et al. 1995
Rana cateisbeiana Tadpole, 0.5-1 cm	immobilization	1	d	TC		2000	Berrill et al. 1995
Rana cateisbeiana Tadpole, 0.5-1 cm	mortality	1	d	TC		9000	Berrill et al. 1995
Rana clamitans Tadpole, 0.5-1 cm	immobilization	1	d	TC		9000	Berrill et al. 1995
Rana pipiens Tadpole	immobilization	1	d	TC		4000	Berrill et al. 1994
Rana pipiens Tadpole, 0.5-1 cm	immobilization	1	d	TC		9000	Berrill et al. 1995
Rana sylvatica Tadpole, 0.5-1 cm	immobilization	1	d	TC		9000	Berrill et al. 1995

Species	Effect	Time		Value	Conc. [µg/l]	Reference
Fish						
Carassius auratus	behaviour	15	min	LOEC	10	Scherer 1975
Cyprinus carpio	hematologic effect	1	d	EC	0.0096	Svobodova 1975
Galaxias maculatus	respiration (oxygen consumption)	20	d	NOEC	≥ 0 < 15	Davies et al. 1994
Oncorhynchus mykiss	AChE activity, respiration	20	d	NOEC	≥ 0 < 15	Davies et al. 1994
Pimephales promelas (embryos 6-12 h old)	biomass	31	d	NOEC MATC	> 130 < 300	Kleiner et al. 1984
Salmo salar	behaviour	7	d	EC	0.004	Morgan & Kiceniuk 90
Crustaceans						
Callinectes sapius	regeneration	3	d	EC	0.01	Johnston & Corbett 85
Paratya australiensis	mortality	10	d	NOEC	≥ 1.3 < 5.4	Davies et al. 1994

4.2 Bioaccumulation

Species	Effect	Time		Test	Value	Reference
Fish						
Cyprinus carpio	residue	7	d	BCF	33.1-93.8	Tsuda et al. 1990
Gnathopogon coerulescens	residue	7	d	BCF	364	Tsuda et al. 1989
Oncorhynchus mykiss	residue	1-3	d	BCF	200-250	Miyamoto et al. 1979
Oryzias latipes	residue	7	d	BCF	235-339	Takimoto et al. 1987
Oryzias latipes	residue	7	d	BCF	520-540	Takimoto et al. 1984
Poecilia reticulata	residue	3-11	d	BCF	0.229	De Bruijn& Hermens 1991
Pseudorasbora parva	residue	1-14	d	BCF	246	Kanazawa, J. 1981

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Fenthion
CAS Number: 55-38-9

Quality Target

Protected Asset	Water (µg/l)
Aquatic Communities	0.004
Drinking Water Supply	0.1

1. General

Fenthion is a triphosphoric acid ester that is used as an insecticide which inhibits choline esterase. In Germany it is mainly applied to control cherry tree pests. The most important use of fenthion is to control disease-transmitting midges (especially mosquitoes) in tropical countries. Where fenthion is used to control midges (USA, Iran, Bangkok, India) it is often found in surface waters. In South Africa it is used along rivers to poison finches (Roux et al., 95). Pesticides containing the active ingredient fenthion are authorized in Germany (BBA, 1998).

2. Aquatic Communities

NOEC data from longer-term tests to assess the ecotoxicological effects are available for algae, crustaceans and fish. No data are available for bacteria. However, fenthion is not known to have a negative effect on the soil microflora (BBA/0057/93/06). Crustaceans are the most sensitive species to fenthion. The quality target for aquatic communities was derived by multiplying the NOEC (21 d) for Daphnia magna by the compensation factor F1 = 0.1. (QT = 0.042 µg/l x 0.1 = 0.0042 µg/l, rounded 0.004 µg/l). The quality target for fenthion is 0.004 µg/l.

3. Drinking Water Supply

The maximum value of 0.1 µg/l determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is 0.1 µg/l.

4. Test Results

4.1 Aquatic Toxicity

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Fenthion 55-38-9							
Algae							
Scenedesmus subspicatus	no data	4	d	NOEC		100	PSM database
Scenedesmus subspicatus	cell multiplication (biomass)	4	d	EC 50		550	PSM database
Scenedesmus subspicatus	cell multiplication (growth rate)	4	d	EC 50		1790	PSM database
Crustaceans							
Daphnia magna	mortality, growth (length) and reproduction	21	d	NOEC		0.042	PSM database
Daphnia magna	mortality	21	d	EC 50		0.059	PSM database
Daphnia magna	immobilization	2	d	NOEC		0.076	PSM database
Daphnia magna	immobilization	2	d	EC 50		4.3	PSM database
Daphnia magna	immobilization	1	d	EC 50	>	100	PSM database
Daphnia magna		21	d	LOEC	<	0.08	US EPA 1995
Daphnia pulex	immobilization	2	d	EC 50		0.8	Sanders & Cope 1966
Gammarus lacustris	mortality	4	d	LC 50		8.4	Mayer & Ellersieck 1986
Mysidopsis bahia	no data	4	d	NOEC		0.067	BBA 1995
Palaemonetes kadiakensis	mortality	20	d	LC 50		1.5	Sanders 1972
Paratya compressa improvisa	mortality	2	d	LC 50		1	Hatakeyama & Sugaya 1989
Simocephlus serrulatus	immobilization	2	d	EC 50		0.62	Sanders & Cope 1966
Fish							
Aplocheilus lineatus (25-40 mm)	mortality	2	d	LC 50		490	Jacob et al. 1982
Lepomis macrochirus	no data	4	d	NOEC		410	PSM database
Lepomis macrochirus	mortality	96	d	LC 50		1700	PSM database
Lepomis macrochirus	mortality	1	d	LC 50		2400	PSM database
Lepomis macrochirus	mortality	1	d	LC 50		1800	PSM database
Leuciscus idus melanotus	mortality	4	d	LC 50		1890	PSM database
Oncorhynchus mykiss	no data	88	d	NOEC		13	PSM database
Oncorhynchus mykiss	larval length	88	d	LOEC		27	PSM database

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Oncorhynchus mykiss	loss of equilibrium	4	d	NOEC	<	110	PSM database
Oncorhynchus mykiss	mortality	4	d	LC 50		830	PSM database
Oncorhynchus mykiss	mortality	1	d	LC 50		1400	PSM database
Oncorhynchus mykiss	mortality	4	d	LC 0		350	PSM database
Oncorhynchus mykiss	mortality	4	d	LC 50		610	PSM database
Oncorhynchus mykiss	mortality	4	d	LC 100		980	PSM database
Oncorhynchus mykiss	mortality	1	d	LC 50		610	PSM database
Oncorhynchus mykiss	mortality	1	d	LC 50		840	PSM database
Salmo gairdneri	mortality	4	d	LC 50		930	Johnson & Finley 1980
Tilapia leucosticta	biomass	63	d	LOEC	≤	1000	Paflitschek 1979
Other Species and/or Parameters							
Phytoplankton and zooplankton group	species composition, density of individuals	54	d	TC		50, 500	Hanazato & Kasai 1995
Fish							
Lepomis macrochirus	AChE inhibition	15	d	TC		20	Weiss & Gakstatter 1964
Insects							
Acroneuria pacifica	mortality	4	d	LC 50		5.1	Gaufin et al. 1965
Cloen sp. (larvae)	mortality	2	d	LC 50		12	Bluzat & Seuge 1979
Cules tritaeniorhynchus	mortality	1	d	LC 50		5.6	Shim & Self 1973
Shells							
Indonaia caeruleus	metabolism	4	d	LOEC		7.2	Mane et al. 1986
Indonaia caeruleus	mortality	4	d	LC 50		13.6	Mane & Akartes 1988

4.2 Bioaccumulation

Species	Effect	Time	Test	Value	Reference
Amphibians					
Rana catesbeiana	bioaccumulation		BCF	62	Hall & Kolbe 1980

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Hexazinone

3-cyclohexyl-6-(dimethylamino)-1-methyl-1,3,5-triazine-2,4(1*H*,3*H*)-dione
CAS Number: 51235-04-2

Quality Target

Protected Asset	Water (µg/l)
Aquatic Communities	0.07
Drinking Water Supply	0.1

1. General

Hexazinone is a non-selective herbicide from the triazine chemical family. It is absorbed through the leaves and roots and inhibits photosynthesis. It is mainly applied as a non-selective herbicide on non-cultivated land and in gardens and parks. Hexazinone is used during the main growth period.
Pesticides containing the active ingredient hexazinone are not authorized in Germany (BBA, 1998).

2. Aquatic Communities

Results from longer-term tests to assess the ecotoxicological effects are available for algae, crustaceans and fish. However, only EC50 values are available for algae. No data are available for bacteria. Due to the mode of action it is assumed that tests on bacteria are not relevant to the derivation of quality targets. The most sensitive test results are listed in section 4. The lowest value was recorded for algae (Selenastrum capricornutum) with an EC50 of 6.8 µg/l. In order to assess an NOEC, this value was multiplied by 0.1.
(6.8 µg/l x 0.1 = 0.68 µg/l).
The quality target for aquatic communities was derived by multiplying the extrapolated NOEC of the most sensitive algae species by the compensation factor F1 = 0.1.
(QT = 0.68 µg/l x 0.1 = 0.068 µg/l, rounded QT = 0.07 µg/l). The quality target for hexazinone is 0.07 µg/l.

3. Drinking Water Supply

The maximum value of 0.1 µg/l determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is 0.1 µg/l.

4. Test Results

Species	Effect	Time	Value	Conc. [µg/l]	Reference
Hexazinone					
51235-04-2					
Algae					
Selenastrum capricornutum	no data	5 d	EC50	6.8	EPA 1995
Selenastrum capricornutum	growth	5 d	EC50	85	Abou-Waly et al. 1991
Selenastrum capricornutum	growth	3 d	EC50	56	Abou-Waly et al. 1991
Selenastrum capricornutum	growth ^{14}C fixation	7 d 1 d	EC50 EC50	126 14-219	Abou-Waly et al. 1991
Crustaceans					
Cladocera	abundance	42 d	EC50	90	Thompson et al. 1993
Copepoda	abundance	42 d	EC50	320	Thompson et al. 1993
Mysidopsis bahia	no data	4 d	NOEC	31000	PSM database
Daphnia magna	no data	2 d	EC50	151600	PSM database
Daphnia magna	no data	21 d	EC50	33100	EPA 1995
Daphnia magna	no data	21 d	LOEC	50000	EPA 1995
Mysidopsis bahia	no data	4 d	LC50	227000	PSM database
Fish					
Pimephales promelas	no data	39 d	LOEC	35500	EPA 1995
Pimephales promelas	no data	4 d	LC0	160000	PSM database
Oncorhynchus mykiss	no data	4 d	LC0	250000	PSM database
Other Species and/or Parameters					
Amphibians					
Rana catesbeiana	hatching	1 d	LOEC	100	PSM-Datenbanl
Rotifers					
Keratella cochlearis	abundance	21 d	EC50	40	Thompson et al. 1993

Species	Effect	Time	Value	Conc. [µg/l]	Reference
Insects					
Leucrocuta sp.	drift	2 h	TC	8000	Kreutzweiser et al. 1991
Plants					
Lemna minor	growth	7 d	TC	2867	Peterson et al. 1994

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Environmental Toxicology and Chemistry 12, 1709-1717

Isoproturon

N,N-dimethyl-*N'*-[4-(1-methylethyl)phenyl]urea
CAS Number: 34123-59-6

Quality Target

Protected Asset	Water (µg/l)
Aquatic Communities	0.3
Drinking Water Supply	0.1

1. General

Isoproturon is a selective herbicide from the group of urea derivatives. It is absorbed through the roots and leaves. Once inside the plant it moves primarily through the xylem and to a lesser extent through the phloem. Isoproturon inhibits photosynthetic electron transport. It is mainly applied as a pre- and post-emergence herbicide to control grass weed in winter wheat, winter barley, rye, summer barley and summer wheat.
Pesticides containing the active ingredient isoproturon are authorized in Germany (BBA, 1998).

2. Aquatic Communities

Results from long-term tests to assess the ecotoxicological effects are available for bacteria, algae, crustaceans and fish. The most sensitive test results are listed in section 4. The lowest value from long-term tests was recorded for algae (Scenedesmus subspicatus) with an NOEC of 3.2 µg/l.
Herbicides containing only isoproturon as an active ingredient have a similar effect on algae as the active ingredient itself. However, a combination with mecoprop produces a synergistic effect. Compared to the active ingredient itself the formulations have a less significant effect on daphnia while they have a similar effect on fish (*BBA Wirkstoffdatenblatt*, 1993).
The quality target for aquatic communities was derived by multiplying the NOEC of the most sensitive algae species by the compensation factor F1 = 0.1.
(QT = 3.2 µg/l x 0.1 = 0.32 µg/l, rounded = 0.3 µg/l). The quality target for isoproturon is 0.3 µg/l.

3. Drinking Water Supply

The maximum value of 0.1 µg/l determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is 0.1 µg/l.

4. Test Results

Species	Effect	Time	Value		Conc. [µg/l]	Reference
Isoproturon 34123-59-6						
Bacteria						
Pseudomonas putida	cell multiplication	3 d	NOEC		35000	Bruns & Knacker 1998
Algae						
Chlorella pyrenoidosa	growth	4 d	NOEC (50% a.i.)	<	2	Anton et al 1993
Scenedesmus subspicatus	no data	4 d	NOEC		3.2	BBA 1993
Scenedesmus subspicatus	multiplication inhibition	3 d	NOEC		3.2	PSM database 1986
Scenedesmus subspicatus	biomass	3 d	EC10		5	PSM database 1992
Scenedesmus subspicatus	growth	3 d	NOEC		8	PSM database 1992
Scenedesmus subspicatus	cell multiplication	3 d	EC10		17	PSM database 1992
Chlorella pyrenoidosa	growth	4 d	EC50		20	Anton et al. 1993
Chlorella pyrenoidosa	growth	4 d	EC50		25	Anton et al. 1993
Scenedesmus subspicatus	no data	4 d	EC50		30	BBA 1993
Scenedesmus subspicatus	multiplication inhibition	3 d	EC50		30	PSM database 1986
Scenedesmus subspicatus	biomass	3 d	EC50		30	PSM database 1992
Scenedesmus subspicatus	cell multiplication	3 d	EC50		95	PSM database 1992
Crustaceans						
Daphnia magna	reproduction	21 d	NOEC		64	BBA 1993
Daphnia magna	reproduction	21 d	NOEC		93	PSM database 1990
Daphnia magna	no data	2 d	EC0		120	PSM database 1989
Daphnia magna	reproduction	21 d	LOEC		320	BBA 1993
Daphnia magna	immobilization	21 d	EC0		340	PSM database 1990
Daphnia magna	immobilization	21 d	EC50		340	PSM database 1990
Daphnia magna	reproduction	21 d	NOEC		410	PSM database 1992
Daphnia magna	no data	2 d	EC50		490	PSM database 1989
Daphnia magna	no data	2 d	EC50		710	PSM database 1989
Daphnia magna	immobilization	21 d	EC50		1240	PSM database 1990
Daphnia magna	immobilization	21 d	EC100		1240	PSM database 1990
Daphnia magna	no data	2 d	EC100		3290	PSM database 1989
Daphnia magna	immobilization	21 d	NOEC		8900	PSM database 1992

Species	Effect	Time	Value	Conc. [µg/l]	Reference
Fish					
Oncorhynchus mykiss	growth	21 d	NOEC	1000	BBA 1993
Oncorhynchus mykiss	behaviour	21 d	NOEC	1140	PSM database 1992
Oncorhynchus mykiss	no data	21 d	NOEC	2100	PSM database 1990
Oncorhynchus mykiss	growth	21 d	LOEC	3200	BBA 1993
Oncorhynchus mykiss	growth	21 d	LOEC	4300	PSM database 1990

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Wirkstoffdatenblatt Isoproturon,
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Environmental Research Report No.: 10601067, Federal Ministry of the Environment, Nature Conservation and Nuclear Safety, Bonn

PSM-Datenbank (PSM database),
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Lindane

CAS Number: 58-89-9

Quality Target

Protected Asset	Water (µg/l)
Aquatic Communities	0.3
Drinking Water Supply	0.1

1. General

Lindane, also known as γ-hexachlorocyclohexane (γ-HCH), is a chlorinated hydrocarbon that acts as a poison on contact, oral consumption or inhalation. It is no longer produced and was formerly used in farming, forests, drugs, protection of stored goods, wood preservation and disinfestations. The manufacturing process of the technical product, which has been prohibited as an insecticide in the European Community since 1981, creates an α, β, γ and δ HCH mixture. The α, β and δ HCH isomers are also relevant to some protected assets. Lindane is suspected to affect the reproductive capability and the endocrine system (*UBA-Texte 65/95*). Pesticides containing the active ingredient lindane are authorized in Germany (BBA, 1998).

2. Aquatic Communities

NOEC and LOEC data from longer-term tests to assess the ecotoxicological effects are available for bacteria, algae, crustaceans and fish. There is a study describing that lindane is highly toxic to insects. However, that study is not consistently plausible.

The quality target for aquatic communities was derived by multiplying the NOEC (10 d) value for Gammarus pulex (2.7 µg/l) by the compensation factor F1 = 0.1.
(QT = 2.7 µg/l x 0.1 = 0.27 µg/l, rounded 0.3 µg/l). The quality target for lindane is 0.3 µg/l.

3. Drinking Water Supply

The maximum value of 0.1 µg/l determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is 0.1 µg/l.

4. Test Results

4.1 Aquatic Toxicity

Species	Effect	Time	Value	Conc. [µg/l]	Reference
Lindane 58-89-9					
Bacteria					
Pseudomonas putida	cell multiplication	16 h	LOEC	> 5000	Bringmann & Kühn 1977
Algae					
Microcystis aeroginosa	cell multiplication	8 d	EC 3	300	Bringmann 1978
Scenedesmus acutus	cell multiplication	5 d	EC 20	1000	Krishnakumari 1977
Scenedesmus quadricauda	cell multiplication	8 d	EC 3	1900	Bringmann 1978
Scenedesmus subspicatus	cell multiplication	4 d	EC 10	500	Geyer et al. 1985
Scenedesmus subspicatus	cell multiplication	4 d	EC 50	2500	Geyer et al. 1985
Scenedesmus subspicatus	cell multiplication	3 d	NOEC	1400	Schäfer et al. 1994
Scenedesmus subspicatus	cell multiplication	3 d	EC 50	3200	Schäfer et al. 1994
Crustaceans					
Asellus brevicaudus	mortality	4 d	LC 50	10	Sanders 1972
Cypridopsis vidua	mortality	4 d	LC 50	3.2	Johnson & Finley 1980
Daphnia magna	reproduction	64 d	NOEC	> 11 < 19	Macek et al. 1976
Daphnia magna	growth (length)	16 d	NOEC	150	Deneer et al. 1988
Daphnia magna	growth (length)	16 d	EC 10	330	Deneer et al 1988
Daphnia magna	reproduction	16 d	EC 50	340	Hermens et al. 1984
Daphnia magna	reproduction	21 d	NOEC	54	PSM database
Daphnia magna	no data	14 d	NOEC	100	PSM database
Daphnia magna	immobilization	1 d	EC 0	< 3	Knie et al. 1983
Daphnia magna	immobilization	2 d	EC 50	485	PSM database
Daphnia magna	immobilization	1 d	EC 50	1250	Frear & Boyd 1967
Daphnia pulex	immobilization	2 d	EC 50	460	Mayer & Ellersieck 1986
Eurypanopeus depressus (1-4 days old larvae)	mortality	21 d	LC 50	0.01	Shirley & McKenney 1987
Eurypanopeus depressus (1-4 days old larvae)	mortality	4 d	LC 50	0.66	Shirley & McKinney 1987
Eurypanopeus depressus (adults)	mortality	4 d	LC 50	25	Shirley & McKinney 1987

Species	Effect	Time		Value	Conc. [µg/l]	Reference
Gammarus fasciatus	mortality	120	d	NOEC	4 3	Macek et al. 1976
Gammarus fasciatus	reproduction	120	d	NOEC	> 4.3 < 8.6	Macek et al. 1976
Gammarus fasciatus	mortality	4	d	LC 50	10	Sanders 1972
Gammarus pulex	mortality	10	d	LC 50	7	Taylor 1991
Gammarus pulex	mortality	4	d	LC 50	79	Taylor 1991
Gammarus pulex	immobilization	4	d	EC 50	10.7	Taylor, unpublished
Gammarus pulex	mortality	4	d	LC 50	5.9	Stephenson 1983
Gammarus pulex	growth	10	d	NOEC	2.67	PSM database
Gammarus pulex	growth	14	d	LOEC	6.11	PSM database
Macrobrachium kistnensis	mortality	4	d	LC 50	8.6	Pawar & Katdare 1983
Palaemonetes kadiakensis		1	d	LC 50	5.1	Naqvi & Ferguson 1970
Penaeus duorarum (1-4 days old larvae)	mortality	4	d	LC 50	0.17	Schimmel et al. 1977
Fish						
Anguilla anguilla		1	d	LC 50	670	Ferrando et al. 1987
Barbus sophore	mortality	4	d	LC 50	1.5	Khillare 1988
Brachydanio rerio	mortality, development, growth (ELS)	35	d	NOEC	40	Görge & Nagel 1990a
Brachydanio rerio	larval growth (ELS)	35	d	LOEC	80	Görge & Nagel 1990a
Brachydanio rerio	mortality (ELS)	35	d	LC 50	118	Görge & Nagel 1990a
Clarius batrachus	mortality	4	d	LC 50	1.1	Kudesia & Bali 1984
Clarius batrachus	mortality	3	d	LC 50	3.4	Kudesia & Bali 1984
Clarius batrachus	mortality	2	d	LC 50	7.3	Kudesia & Bali 1984
Clarius batrachus	mortality	1	d	LC 50	15	Kudesia & Bali 1984
Lepomis macrochirus	mortality	23	d	NOEC	> 9.1 <12.5	Macek et al. 1976
Lepomis macrochirus	mortality	4	d	LC 50	25	Mayer & Ellersieck 1986
Lepomis macrochirus	mortality	1	d	LC 50	34	Mayer & Ellersieck 1986
Lepomis macrochirus	mortality	1	d	LC 50	61	PSM database,
Leuciscus idus	mortality	2	d	LC 0	9	Knie et al. 1983
Leuciscus idus	mortality	2	d	LC 50	10	Knie et al. 1983
Macropodus opercularis	mortality	2	d	LC 50	4.6	Zambriborshch & Lay 1976
Macropodus opercularis	mortality	2	d	LC 50	8.4	Zambriborshch & Lay 1976
Oncorhynchus kisutch	mortality	4	d	LC 50	23	Johnson & Finley 1980

Species	Effect	Time		Value	Conc. [µg/l]	Reference
Oncorhynchus mykiss	larval weight, ELS	85	d	NOEC	2.9	PSM database
Oncorhynchus mykiss	larval weight, ELS	85	d	LOEC	6	PSM database
Oncorhynchus mykiss	no data	14	d	NOEC	8	PSM database
Oncorhynchus mykiss	mortality	1	d	LC 50	30	PSM database
Oryzias latipes		72	d	LC 50	1.2	Shim & Self 1973
Salmo gairdneri	mortality	4	d	LC 50	18	Mayer & Ellersieck 1986
Salmo gairdneri	mortality	2	d	LC 50	18	Tscheu-Schlüter & Skibba 1986
Salmo gairdneri	mortality	4	d	LC 50	22	Cope 1965
Salmo irideus	mortality	25	d	TC	1000	Boulekbache & Spiess 1974
Salmo trutta	mortality	4	d	LC 50	1.7	Johnson & Finley 1980
Salmo trutta	mortality	4	d	LC 50	2	Macek & McAllister 1970
Salvelinus namaycush	mortality	4	d	LC 50	24	Mayer & Ellersieck 1986
Savelinus fontinalis	growth	261	d	NOEC	> 8.8 < 16.6	Macek et al. 1976
Tilapia zillii	mortality	4	d	LC 50	6.4	El-Sebae et al. 1986
Other Species and/or Parameters						
Fish						
Channa punctatus	ATPase activity	4	d	TC	30	Gopal et al. 1993
Insects						
Chironimus riparius	emergence time	28	d	LOEC	0.8	PSM database Maund et al. 1992
Chironimus riparius	mortality	10	d	LC 50	13	Taylor et al. 1991
Chironimus riparius	mortality	5	d	LC 50	27	Taylor et al. 1991
Chironimus riparius	mortality	4	d	LC 50	34	Taylor et al. 1991
Limnephilus lunatus	mortality	90	d	emergence rate	0.0001	Schulz & Liess 1995

4.2 Bioaccumulation

Species	Effect	Time	Test	Value	Reference
Fish					
Brachydanio rerio	residue	2 d	BCF	124-496	Görge & Nagel 1990b
Brachydanio rerio	residue	2 d	BCF	557-1197	Ensenbach & Nagel 1991
Gambusia affinis	residue	33 d	BCF	560	Metcalf et al. 1973
Labidesthes sicculus	residue	4 d	BCF	1613	Matsumara 1977
Lepomis macrochirus	residue	735 d	BCF	23-45	Macek et al. 1976
Pimephales promelas	residue	304 d	BCF	284-674	Macek et al. 1976
Salvelinus fontinalis	residue	261 d	BCF	51-108	Macek et al. 1976

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Linuron

N'-(3,4-dichlorophenyl)-*N*-methoxy-*N*-methylurea
CAS Number: 330-55-2

Quality Target

Protected Asset	Water (µg/l)
Aquatic Communities	0.3
Drinking Water Supply	0.1

1. General

Linuron is a selective systemic herbicide from the group of urea derivatives. It inhibits the electron transport in the photosystem II. Linuron is absorbed through the roots or leaves. It is transported mainly acropetally in the xylem. Linuron is primarily applied to control seed weed in potatoes, maize, vegetable, ornamental plants and ornamental wood.
Pesticides containing the active ingredient linuron are not authorized in Germany (BBA, 1998).

2. Aquatic Communities

Results from longer-term tests to assess the ecotoxicological effects are available for algae, crustaceans and fish. No data are available for bacteria. The lowest value was recorded for algae (Ankistrodesmus falcatus) with an NOEC of 2.5 µg/l. Similar values were recorded for macrophytes.

The quality target for aquatic communities was derived by multiplying the NOEC of the most sensitive alga species by the compensation factor F1 = 0.1.
(QT = 2.5 µg/l x 0.1 = 0.25 µg/l, rounded QT = 0.3 µg/l).

3. Drinking Water Supply

The maximum value of 0.1 µg/l determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is 0.1 µg/l.

4. Test Results

Species	Effect	Time	Value	Conc. [µg/l]	Reference
Linuron					
330-55-2					
Algae					
Ankistrodesmus falcatus	no data	10 d	NOEC	2.5	BBA 1993
Ankistrodesmus falcatus	no data	10 d	LOEC	3.4	BBA 1993
Ankistrodesmus falcatus	no data	10 d	LC50	4.9	BBA 1993
Scenedesmus subspicatus	growth	3 d	NOEC	5.6	PSM database 1996
Scenedesmus subspicatus	growth	3 d	EC10	9.5	PSM database 1996
Scenedesmus subspicatus	growth	3 d	EC50	16	PSM database 1996
Chlorella vulgaris	growth	7 d	EC50	50	Stephenson &Kane 1984
Selenastrum capricornutum	no data	5 d	EC50	70	EPA 1995
Crustaceans					
Mysidopsis bahia	no data	4 d	NOEC	31	PSM database 1996
Daphnia magna	no data	2 d	EC50	120	EPA 1995
Daphnia magna	no data	21 d	LOEC	240	EPA 1995
Daphnia magna	immobilization	1 d	EC50	310	Stephenson & Kane 1984
Daphnia magna	reproduction	21 d	NOEC	320	BBA 1993
Daphnia magna	no data	2 d	NOEC	320	BBA 1993
Mysidopsis bahia	no data	4 d	LC50	432	PSM database 1996
Daphnia magna	no data	2 d	LC50	750	BBA 1993
Fish					
Oncorhynchus mykiss	mortality	2 d	LC100	50000	Lysak & Marcinek 1972
Oncorhynchus mykiss	growth	21 d	LOEC	500	BBA 1993
Oncorhynchus mykiss	growth	21 d	LC50	700	BBA 1993
Oncorhynchus mykiss	growth	21 d	LC100	1000	BBA 1993
Plants					
Lemna minor	growth	5 d	EC50	70	Stephenson & Kane 1984

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Malathion
CAS Number: 121-75-5

Quality Target

Protected Asset	Water (µg/l)
Aquatic Communities	0.02
Drinking Water Supply	0.1

1. General

Malathion is an organophosphorus compound that inhibits choline esterase and is used as an insecticide. Pesticides containing the active ingredient malathion are not authorized in Germany (BBA, 1998).

2. Aquatic Communities

NOEC values from longer-term tests to assess the ecotoxicological effects are available for algae, crustaceans and fish. Only data from acute tests are available for bacteria. Crustaceans are the most sensitive species to malathion.
The quality target for aquatic communities was derived by multiplying the NOEC (21 d) for Daphnia magna (0.15 µg/l) by the compensation factor F1 = 0.1.
(QT = 0.15 µg/l x 0.1 = 0.015, rounded 0.02 µg/l). The quality target for malathion is 0.02 µg/l.

3. Drinking Water Supply

The maximum value of 0.1 µg/l determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is 0.1 µg/l.

4. Test Results

4.1 Aquatic Toxicity

Species	Effect	Time		Value	Conc. [µg/l]	Reference
Malathion 121-75-5						
Bacteria						
Photobacterium fischeri	bioluminescence	2	min	EC 2	1000	Bulich et al. 1979
Photobacterium phosphoreum	bioluminescence	5	min	EC 50	3000	Bulich et al. 1981
Algae						
Anabaena	cell multiplication	5	d	NOEC	10000	Tandon et al. 1988
Aulosira fertilissima	cell multiplication	5	d	NOEC	50000	Tandon et al. 1988
Chlorella pyrenoidosa	cell multiplication	7	d	EC 10	100	Christie 1969
Chlorella pyrenoidosa	cell multiplication	3	d	EC 30	100000	Christie 1969
Crustaceans						
Daphnia magna	immobilization	21	d	NOEC	0.15	Dortland 1980
Daphnia magna	reproduction	21	d	NOEC	0.3	Dortland 1980
Daphnia magna	immobilization	26	h	EC 50	0.9	Crosby et al. 1966
Daphnia magna	immobilization	1	d	EC 50	0.9	Frear & Boyd 1967
Eucyclops sp.	mortality	2	d	LC 50	1.0	Naqvi & Hawkins 1989
Gammarus fasciatus	mortality	2	d	LC 50	0.5	Sanders 1972
Gammarus lacustris	mortality	4	d	LC 50	1.0	Sanders 1969
Fish						
Barbus ticto	mortality	4	d	LC 50	8.9	Bhatia 1971
Brachydanio rerio	mortality	4	d	LC 50	19.8	Becker et al. 1990
Channa punctatus	mortality	4	d	LC 50	4600	Haider & Inbaraj 1986
Channa punctatus	mortality	3	d	LC 50	5240	Haider & Inbaraj 1986
Channa punctatus	mortality	2	d	LC 50	6510	Haider & Inbaraj 1986
Channa punctatus	mortality	1	d	LC 50	9480	Haider & Inbaraj 1986
Jordanella floridae (ind. 2-3 days old)	growth in length	30	d	NOEC	13.8	Hermanutz et al. 1985
Jordanella floridae (ind. 2-3 days old)	mortality (>10%)	30	d	LOEC	23.1	Hermanutz et al. 1985

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Jordanella floridae (1-2 days old larvae)	survival rate, growth in length	30	d	LOEC		24.7	Hermanutz 1978
Lepomis macrochirus	mortality	1	d	LC 50		120	PSM database,
Notropis lutrensis	mortality	5	d	LC 50		40.4[1]	Smith et al. 1968
Oncorhynchus mykiss	mortality	5	d	LC 50		4.04[1]	Smith et al. 1968
Oncorhynchus mykiss	mortality	1	d	LC 50		100	PSM database,
Oncorhynchus tshawytscha	mortality	4	d	LC 50		23	Katz 1961
Other Species and/or Parameters							
Algae							
Anabaena	nitrogen fixation (nitrogenase activity)	4	d	NOEC	≥	100000	Tandon et al. 1988
Anabaena	photosynthesis ($^{14}CO_2$ uptake)	90	min	NOEC	≥	100000	Tandon et al. 1988
Aulosira fertilissima	nitrogen fixation (nitrogenase activity)	4	d	LOEC		10000	Tandon et al. 1988
Aulosira fertilissima	photosynthesis ($^{14}CO_2$ uptake)	90	min	NOEC		10000	Tandon et al. 1988
Chlamydomonas reinhardtii	reproduction (zygote cell division)	2	h	EC 50		330360	Netrawali et al. 1986
Euglena gracilis	population growth	5	d	NOEC		1450	Moore 1970
Amphibians							
Bufo woodhousei fowleri	mortality	4	d	LC 50		420	Sanders 1970
Bufo woodhousei fowleri	mortality	1	d	LC 50		1900	Sanders 1970
Pseudacris triseriata	mortality	4	d	LC 50		200	Sanders 1970
Pseudacris triseriata	mortality	1	d	LC 50		560	Sanders 1970
Unicellular organisms							
Paramecium aurelia	cell multiplication	3	d	NOEC		> 1000 < 10000	Tandon et al. 1987
Fish							
Brachydanio rerio (embryo)	heart beat rate	2	d	NOEC		1.3	Schulte & Nagel 1994
Brachydanio rerio (embryo)	heart beat rate	2	d	LOEC		2.6	Schulte & Nagel 1994

[1] converted from 57% to 100% active ingredient

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Brachydanio rerio (embryo)	number of somatic cells	16	h	NOEC		1.3	Schulte & Nagel 1994
Brachydanio rerio (embryo)	number of somatic cells	16	h	LOEC		2.6	Schulte & Nagel 1994
Brachydanio rerio (embryo)	embryo development (different parameters)	12-48	h	EC 50		0.6-7.6	Schulte & Nagel 1994
Carassius auratus	AChE inhibition	15	d	TC		1	Weiss & Gakstatter 1964
Clarius batrachus	thyroid balance	16	d	EC		3.5	Sinha et al. 1992
Clarius batrachus	thyroid balance	4	d	EC		7	Sinha et al. 1992
Labeo rohita, Indian carp	optomotor response	1	d	LOEC	≤	200	Dutta et al. 1992
Lepomis macrochirus	AChE inhibition	15	d	TC		1	Weiss & Gakstatter 1964
Lepomis macrochirus	inhibition of choline esterase activity	1	d	LOEC		> 8 > 16	Richmonds & Dutta 1992
Lepomis macrochirus	inhibition of choline esterase activity	1	d	EC 50		> 16 > 32	Richmonds & Dutta 1992
Lepomis macrochirus	mortality, growth, reproduction in field test	78	d	TC	>	20.0	Kennedy 1970
Netomigomus crysoleucus	AChE inhibition	15	d	TC		1	Weiss & Gakstatter 1964
Insects							
Benthic community (Chironomidae, Baetidae and Heptageniidae)	abundance	78	d	TC		20	Kennedy 1970
Hydropsyche bettonie	mortality	1	d	LC 50		0.34	Dortland 1980
Worms							
Schistosoma mansoni (Cercariae)	mortality	4	h	LC 50		69360	Tchounwou & Englande 1992
Tubificidae	mortality	4	d	LC 50		16700	Whitten 1966

4.2 Bioaccumulation

Species	Effect	Time		Test	Value	Reference
Fish						
Cyprinus carpio	residue	7	d	BCF	1.3-8.7	Tsuda et al. 1990
Gnathopogon coerulescens	residue	7	d	BCF	37.8	Tsuda et al. 1989

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MCPA
(4-chloro-2-methylphenoxy)acetic acid
CAS Number: 94-74-6

Quality Target

Protected Asset	Water (µg/l)
Aquatic Communities	2.0
Irrigation	(0.16 / 0.03)
Drinking Water Supply	0.1

1. General

MCPA is a herbicide from the group of phenoxycarboxylic acids. The mode of action of MCPA could not be fully clarified to date. Basically it influences the nucleid acid metabolism of plants. It inhibits photosynthesis while carbon hydrate production is reduced. At the same time a massive uncontrolled cell multiplication has been observed. MCPA is mainly used - also in combination with other herbicides - in cereal farming and grassland farming to control dicotyledonous weed (BBA, 1993). Apart from MCPA in acid form, various salt and ester variants are used, e.g. MCPA potassium salt, MCPA sodium salt, MCPA dimethylamine salt, MCPA-2 ethylhexyl ester, MCPA butoxyethyl ester and MCPA isooctyl ester. Ester hydrolysis depends on the pH value; it is much slower in the acid segment.

Pesticides containing the active ingredient MCPA are authorized in Germany. According to the list of authorized pesticides no products containing MCPA ester are authorized in Germany (BBA, 1998).

2. Aquatic Communities

Results from longer-term tests to assess the ecotoxicological effects are available for algae, crustaceans, fish and other species groups. The most sensitive test results for MCPA including its salt and ester variants are listed in section 4. The test results of MCPA ester variants were not used to derive a quality target as they hydrolyze quickly into MCPA. However, MCPA ester variants are more toxic to crustaceans and fish than MCPA itself. MCPA and MCPA ester variants are almost equally toxic to algae and aquatic plants.

No aquatic test results are available for bacteria. Tests on the effect on soil microflora activities (long-term respiration, nitrification) with 1 time and 10 times the application rate (0.05 and 0.5 g/m^3) showed no adverse effects (BBA, 1993). In view of the bacteria test results of 2,4-D (phenoxycarboxylic acid) there is little probability that bacteria represent the most sensitive species group. Tests have shown that MCPA isooctyl ester is more toxic to fish (salmonids) than MCPA and MCPA salts. The NOEC for the most sensitive fish species

Oncorhynchus mykiss, 21 d, was 40 µg/l (MCPA isooctyl ester). The NOEC for Oncorhynchus mykiss in a test lasting 28 days for MCPA dimethylamine salt was 50000 µg/l. According to the test results, the most sensitive species are algae (Navicula pelliculosa and Selenastrum capicornutum, NOEC = 9 µg/l MCPA), blue-green algae (Anabaena flos-aquae, NOEC = 5.3 µg/l MCPA-2 ethylhexyl ester and 6.1 µg/l MCPA dimethylamine salt) and aquatic plants (Lemna gibba, NOEC = 6.5 µg/l MCPA-2 ethylhexyl ester, NOEC = 24 µg/l MCPA dimethylamine salt and NOEC = 130 µg/l MCPA). As regards the toxic effect of MCPA on aquatic plants – which are normally very sensitive to phenoxycarboxylic acids – the only available data refer to Lemna sp. Although the test results for algae and blue-green algae were classified valid by Canadian environmental authorities (Caux et al. 1995), they were not used in the derivation of quality targets as the validity of the test results has been questioned on some occasions. There was no chance to investigate the quality of the tests because the records were not available.

In the case of plants, a combinatory effect can be expected whenever several active ingredients of phenoxycarboxylic acids are present in the water at the same time, due to the mode of action of that substance group.

The quality target for aquatic communities was derived by multiplying the NOEC of the most sensitive duckweed (Lemna gibba, NOEC = 24 µg/l MCPA dimethylamine salt, equivalent to 20 µg/l MCPA) by the compensation factor F1 = 0.1.
(QT = 20 µg/l x 0.1 = 2.0 µg/l).
The quality target for the overall concentration of all MCPA variants and their conversion products (with regard to MCPA) is 2 µg/l.

3. Drinking Water Supply

The maximum value of 0.1 µg/l determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is 0.1 µg/l.

4. Test Results

Species	Effect	Time		Value	Conc. [µg/l]	Reference
MCPA 94-74-6						
Algae						
Laminaria hyperborea	population test	28	d	TC	1000	UNEP/IRPTC
Navicula pelliculosa	cell multiplication	5	d	EC50	630	CCME 1995
Navicula pelliculosa	cell multiplication	5	d	LOEC	26	CCME 1995
Navicula pelliculosa	cell multiplication	5	d	NOEC	9	Caux et al. 1995
Nitzschia sp.	assimilation	22	h	TE	1400	Peterson et al. 1994

Species	Effect	Time		Value		Conc. [µg/l]	Reference
MCPA 94-74-6							
Pseudokirchnerilla subcapitata	no data			NOEC		20000	Koch & Memmert 1993
Scenedesmus quadricauda	cell multiplication	20	d	EC50		85100	Fargasova 1994
Selenastrum capricornutum	assimilation	22	h	TE		1400	Peterson et al. 1994
Selenastrum capricornutum	cell multiplication	5	d	EC50		950	Caux et al. 1995
Selenastrum capricornutum	cell multiplication	5	d	LOEC		26	Caux et al. 1995
Selenastrum capricornutum	cell multiplication	5	d	NOEC		9	Caux et al. 1995
Selenastrum capricornutum	no data			NOEC		117000	Hanstveit 1988
Blue-green algae							
Anabaena flos-aquae	cell multiplication	5	d	EC50		6700	CCME 1995
Anabaena flos-aquae	cell multiplication	5	d	LOEC		1200	CCME 1995
Anabaena flos-aquae	cell multiplication	5	d	NOEC		470	Caux et al. 1995
Pseudoanabaena	assimilation	22	h	TE		1400	Peterson et al. 1994
Aquatic plants							
Lemna minor	growth	7	d	TE		1400	Peterson et al. 1994
Lemna gibba	growth	14	d	LOEC		260	Caux et al. 1995
Lemna gibba	growth	14	d	NOEC		130	Caux et al. 1995
Crustaceans							
Crangon crangon	mortality	48	h	LC50		10000	UNEP/IRPTC
Daphnia magna	immobilization	1	d	EC50	>	100000	Crosby & Tucker 1966
Daphnia magna	mortality	4	d	LC50		11000	Knapek & Lakota 1974
Daphnia magna	mortality	48	h	LC50		172400	Fargasova 1994
Daphnia pulex	mortality	3	h	LC50	>	40000	Nishiuchi & Hashimoto 1967
Daphnia pulex	mortality	3	h	LC50	>	40000	Nishiuchi & Hashimoto 1969
Moina macrocopa	mortality	3	h	LC50	>	40000	Nishiuchi & Hashimoto 1967
Moina macrocopa	mortality	3	h	LC50	>	40000	Nishiuchi & Hashimoto 1969
Paratya australiensis	enzyme activity	10	d	TE		1000	Davies et al. 1994
Paratya australiensis	mortality	10	d	LC 50	>	340	Davies et al. 1994
Fish							
Carassius auratus	mortality	2	d	LC50	>	40000	Nishiuchi & Hashimoto 1967
Carassius auratus	mortality	2	d	LC50	>	40000	Nishiuchi & Hashimoto 1969

Species	Effect	Time		Value		Conc. [µg/l]	Reference
MCPA 94-74-6							
Carassius sp.	mortality	4	d	LC50		45000	Knapek & Lakota 1974
Cyprinus carpio	mortality	2	d	LC50	>	40000	Nishiuchi & Hashimoto 1967
Cyprinus carpio	mortality	2	d	LC50	>	40000	Nishiuchi & Hashimoto 1969
Cyprinus carpio	mortality	4	d	LC50		59000	Knapek & Lakota 1974
Galaxias maculatus	blood values	20	d	TE		2000	Davies et al. 1994
Galaxias maculatus	mortality	20	d	LC50	>	50000	Davies et al. 1994
Gambusia affinis	mortality	1	d	LC50	>	10000	Ahmed 1977
Lepomis macrochirus	mortality	24	h	LC50		164000	UNEP/IRPTC
Lepomis macrochirus	mortality	1	d	LC50		163500	Davis & Hughes 1963
Lepomis macrochirus	mortality	2	d	LC50		163500	Davis & Hughes 1963
Lepomis macrochirus	mortality	4	d	LC50	>	10000	Johnson & Finley 1980
Oncorhynchus mykiss	mortality	20	d	LC50	>	50000	Davies et al. 1994
Oncorhynchus mykiss	plasma values	20	d	TC		50000	Davies et al. 1994
Oncorhynchus mykiss	mortality	2	d	LC0		20000	Lysak & Marcinek 1972
Oncorhynchus mykiss	mortality	20	d	LC 50	>	50000	Davies et al. 1994
Oryzias latipes	mortality	2	d	LC50	>	40000	Nishiuchi & Hashimoto 1967
Oryzias latipes	mortality	2	d	LC50	>	40000	Nishiuchi & Hashimoto 1969
Salmo trutta	mortality	24	h	LC50		147000	UNEP/IRPTC
Salmonidae	mortality	4	d	LC50		25000	Knapek & Lakota 1974
Tinca tinca	mortality	4	d	LC50		45000	Knapek & Lakota 1974
Other Species and/or Parameters							
Insects							
Aedes aegypti	mortality	4	d	LC50		335000	Knapek & Lakota 1974
Shells							
Crassostrea sp.	growth	96	h	EC0		1000	UNEP/IRPTC
Crassostrea virginica	mortality	48	h	LC50		15620	UNEP/IRPTC
Crassostrea virginica	mortality	12	d	LC50		31300	UNEP/IRPTC

Species	Effect	Time		Value		Conc. [µg/l]	Reference
MCPA							
94-74-6							
Cochlea							
Lymnaea stagnalis L.	reproduction	2	m	TC		6308	Woin & Brönmark 1992
Worms							
Tubifex tubifex	mortality	96	h	LC50		171000	Fargasova 1994
MCPA DMA salt							
2039-46-5							
Algae							
Selenastrum capricornutum	no data	96	h	NOEC		117100	BBA 1993
Selenastrum capricornutum	no data	96	h	EC50		928000	BBA 1993
MCPA DMA salt							
2039-46-5							
Blue-green algae							
Anabaena flos-aquae		5	d	EC50		400	Caux et al. 1995
Anabaena flos-aquae		5	d	NOEC		6.1	Caux et al. 1995
Aquatic plants							
Lemna gibba	growth	14	d	EC50		250	Caux et al. 1995
Lemna gibba	growth	14	d	NOEC		24	Caux et al. 1995
Crustaceans							
Daphnia magna	reproduction	21	d	NOEC		50000	BBA 1993
Daphnia magna	reproduction	21	d	LOEC		100000	BBA 1993
Daphnia magna	reproduction	21	d	NOEC		50000	PSM DATABASE
Daphnia magna	reproduction	21	d	LOEC		100000	PSM DATABASE
Fish							
Lepomis macrochirus	no data	96	h	EC50		306000	BBA 1993
Menidia beryllina	no data	96	h	NOEC		152000	BBA 1993
Menidia beryllina	no data	96	h	EC50		441000	BBA 1993
Menidia menidia	no data	96	h	NOEC	<	3000	BBA 1993
Menidia menidia	no data	96	h	EC50		133000	BBA 1993
Oncorhynchus mykiss	no data	96	h	NOEC	<	89000	BBA 1993
Oncorhynchus mykiss	no data	21	d	NOEC		100000	BBA 1993
Oncorhynchus mykiss	no data	96	h	EC50		117000	BBA 1993
Oncorhynchus mykiss	growth	28	d	NOEC		50000	PSM DATABASE

Species	Effect	Time	Value	Conc. [µg/l]	Reference
MCPA-2 ethylhexyl ester					
Blue-green algae					
Anabaena flos-aquae	cell multiplication	5 d	LOEC	17	Caux et al. 1995
Anabaena flos-aquae	cell multiplication	5 d	NOEC	5.3	Caux et al. 1995
Aquatic plants					
Lemna gibba	growth	14 d	LOEC	24	Caux et al. 1995
Lemna gibba	growth	14 d	NOEC	6.5	Caux et al. 1995
MCPA isooctyl ester					
26544-20-7					
Fish					
Oncorhynchus mykiss	mortality	21 d	NOEC	200	BBA 1993
Oncorhynchus mykiss	mortality	21 d	LOEC	1000	BBA 1993
Oncorhynchus mykiss	mortality	21 d	NOEC	40	PSM DATABASE
Oncorhynchus mykiss	mortality	21 d	LOEC	200	PSM DATABASE
Oncorhynchus mykiss	mortality	21 d	EC50	400	PSM DATABASE
Daphnia magna	reproduction	21 d	NOEC	1000	BBA 1993
MCPA sodium salt					
3653-48-3					
Algae					
Ankistrodesmus falcatus	cell multiplication	10 d	TC10	316000	Tscheu-Schlüter & Skibba 1986
Ankistrodesmus falcatus	cell multiplication	10 d	TC50	350000	Tscheu-Schlüter & Skibba 1986
Fish					
Cyprinus carpio	mortality	48 h	LC10	150000	Tscheu-Schlüter & Skibba 1986
Cyprinus carpio	mortality	48 h	LC50	220000	Tscheu-Schlüter & Skibba 1986
Leuciscus idus melanotus	mortality	96 h	LC10	150000	Tscheu-Schlüter & Skibba 1986
Leuciscus idus melanotus	mortality	96 h	LC50	311000	Tscheu-Schlüter & Skibba 1986
Poecilia reticulata	mortality	96 h	LC10	379000	Tscheu-Schlüter & Skibba 1986
Poecilia reticulata	mortality	96 h	LC50	465000	Tscheu-Schlüter & Skibba 1986

Species	Effect	Time	Value	Conc. [µg/l]	Reference
MCPA sodium salt					
3653-48-3					
Other Species and/or Parameters					
Amphibians					
Xenopus laevis	mortality	112 h	LC10	1526397	Bernardini et al. 1996
Xenopus laevis	mortality	112 h	LC50	3607700	Bernardini et al. 1996
Xenopus laevis	teratogeny	112 h	TC10	426260	Bernardini et al. 1996
Xenopus laevis	teratogeny	112 h	TC50	2690820	Bernardini et al. 1996

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Mecoprop-P
(*R*)-2-(4-chloro-2-methylphenoxy)propanoic acid
CAS Number: 16484-77-8

Quality Target

Protected Asset	Water (µg/l)
Aquatic Communities	50
Drinking Water Supply	0.1

1. General

Mecoprop is a herbicide from the group of phenoxycarboxylic acids. Its mode of action is basically characterized by an inhibition of the nucleid acid metabolism. Mecoprop exists as a mixture of two optically active isomers of which only the dextrorotatory form is herbicidally very active. Only pesticides containing the active ingredient mecoprop-P are authorized in Germany (BBA, 1998).

Mecoprop is mainly used - also in combination with other herbicides - in cereal farming and grassland farming to control dicotyledonous weed. Various mecoprop salts are used alongside mecoprop-P (acid). According to the list of authorized pesticides no products containing mecoprop ester are authorized (BBA, 1998).

2. Aquatic Communities

Results from longer-term tests to assess the ecotoxicological effects are available for bacteria, algae, crustaceans, fish and other species groups. The test results for mecoprop including its acid, salt and ester variants are listed in section 4. The test results of the ester variants were not used to derive a quality target as they hydrolyze quickly into mecoprop.

For macrophytes, which are generally more sensitive to phenoxycarboxylic acid, only acute EC50 values for duckweed (Lemna spec.) are available. The most sensitive among the mecoprop-tested species is Lemna minor, number of leaflets, 10 d, EC50 = 5147 µg/l mecoprop. In order to assess an NOEC, this value multiplied by 0.1.
(5147 µg/l x 0.1 = 514.7 µg/l). The most sensitive among the tested algae species (*Pseudokicheriella sub.*, cell multiplication, 3 d, NOEC = 27000 µg/l mecoprop P) proved to be significantly less sensitive than duckweed.
In the case of plants, a combinatory effect can be expected whenever several active ingredients of phenoxycarboxylic acids are present in the water at the same time, due to the mode of action of that substance group.

Tests on crustaceans and fish revealed that mecoprop ester compounds are much more toxic than mecoprop acid. Both appear to react similarly to mecoprop (racemate) and mecoprop-P (R form). The decisive factor for toxicity is the kind of compound (acid, salt or ester). The most sensitive among the tested species is the rainbow trout (Oncorhynchus mykiss, growth, 21 d, NOEC < 4 µg/l mecoprop butoxyethyl ester). However, the effect value is not used to derive a quality target because mecoprop butoxyethyl ester hydrolyzes quickly into mecoprop.

The quality target for aquatic communities was derived by multiplying the extrapolated NOEC for Lemna minor (5147 µg/l x 0.1 = 514.7 µg/l) by the compensation factor F1 = 0.1. (QT = 514.7 µg/l x 0.1 = 51.47 µg/l, rounded QT = 50 µg/l). The quality target for the overall concentration of all mecoprop variants and their conversion products (with regard to mecoprop) is 50 µg/l.

3. Drinking Water Supply

The maximum value of 0.1 µg/l determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is 0.1 µg/l.

4. Test Results

Species	Effect	Time	Value		Conc. [µg/l]	Reference
Mecoprop 93-65-2						
Algae						
Scenedesmus subspicatus	abundance	4 d	EC50		102660	Kirby & Sheahan 1994
Aquatic plants						
Lemna minor	number of leaflets	10 d	EC50		5147	Kirby & Sheahan 1994
Fish						
Anguilla japonica	mortality	2 d	LC50	>	100000	Yokoyama et al. 1988
Rasbora heteromorpha	mortality	1 d	LC50		12000	Alabaster 1969
Rasbora heteromorpha	mortality	2 d	LC50		11000	Alabaster 1969

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Mecoprop							
7085-19-0							
Algae							
Chlorella pyrenoidosa	cell multiplication	4	d	EC50		220000	BBA 1993
Crustaceans							
Daphnia magna	mortality	2	d	LC50		420000	BBA 1993
Daphnia magna	no data	2	d	EC50	>	100000	U.S. EPA 1995
Fish							
Lepomis macrochirus	mortality	4	d	LC50	>	92000	U.S. EPA 1995
Oncorhynchus mykiss	mortality	4	d	LC50		124800	U.S. EPA 1995
Mecoprop-P							
16484-77-8							
Algae							
Pseudokicheriella sub.	cell multiplication	3	d	NOEC		27000	PSM database
Fish							
Lepomis macrochirus	mortality	4	d	NOEC		50000	PSM database
Lepomis macrochirus	mortality	4	d	LC50	>	100000	PSM database
Oncorhynchus mykiss	no data	28	d	NOEC		50000	PSM database
Oncorhynchus mykiss	mortality	28	d	LC0	>	147000	PSM database
Crustaceans							
Daphnia magna	no data	21	d	NOEC		50000	PSM database
Daphnia magna	no data	21	d	LOEC		100000	PSM database
Mecoprop-P isomer (ester)							
Algae							
Selenastrum capricornutum	cell multiplication	4	d	NOEC		686	PSM database
Crustaceans							
Daphnia magna		2	d	EC50		3730	PSM database

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Mecoprop-P isomer (ester)							
Fish							
Oncorhynchus mykiss		4	d	NOEC		158	PSM database
Oncorhynchus mykiss		4	d	LC50		390	PSM database
Mecoprop isooctyl ester							
28473-03-2							
Algae							
Scenedesmus subspicatus	biomass	3	d	EC10		222500	PSM database
Scenedesmus subspicatus	growth rate	3	d	EC10		557500	PSM database
Mecoprop potassium salt							
1929-86-8							
Crustaceans							
Nitocra spinipes	mortality	4	d	LC50		87000	Linden et al. 1979
Fish							
Alburnus alburnus	mortality	4	d	LC50		115000	Linden et al. 1979
Mecoprop butoxyethyl ester							
23359-62-8							
Algae							
Scenedesmus subspicatus	cell multiplication	4	d	NOEC		625	PSM database
Scenedesmus subspicatus	cell multiplication	4	d	LOEC		1250	PSM database
Scenedesmus subspicatus	cell multiplication	3	d	EC50		3543	PSM database
Scenedesmus subspicatus	cell multiplication	4	d	EC50		6075	PSM database
Fish							
Oncorhynchus mykiss	growth	21	d	LOEC	<	4	PSM database
Oncorhynchus mykiss	growth	21	d	NOEC	<	4	PSM database
Oncorhynchus mykiss	mortality	21	d	LC20		11.4	PSM database
Oncorhynchus mykiss	mortality	21	d	LC50		78	PSM database
Oncorhynchus mykiss	mortality	4	d	NOEC	<	110	PSM database
Oncorhynchus mykiss	mortality	4	d	LC50		677	PSM database

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Mecoprop butoxyethyl ester							
23359-62-8							
Crustaceans							
Daphnia magna	reproduction	21	d	LOEC	>	3000	PSM database
Daphnia magna	reproduction	21	d	NOEC	>	3000	PSM database
Daphnia magna	mortality	1	d	NOEC		3685	PSM database
Daphnia magna	mortality	1	d	EC50		30760	PSM database
Mecoprop compd. with N-methylmethanamine (1:1)							
32351-70-5							
Algae							
Navicula pelliculosa	no data	5	d	EC50		240	U.S. EPA 1995
Selenastrum capricornutum	no data	5	d	EC50		292	U S. EPA 1995
Selenastrum capricornutum	no data	5	d	EC50		340	U.S. EPA 1995
Skeletonema costatum	no data	5	d	EC50		200	U.S. EPA 1995
Blue-green algae							
Anabaena flosaquae	no data	5	d	EC50		1150	U S. EPA 1995
Aquatic plants							
Lemna gibba	no data	5	d	EC50		1900	U.S. EPA 1995
Fish							
Lepomis macrochirus	mortality	4	d	LC50	>	112000	U.S EPA 1995
Oncorhynchus mykiss	mortality	4	d	LC50	>	111000	U.S EPA 1995
Mecoprop DMA salt							
66423-09-4							
Bacteria							
Pseudomonas putida	cell multiplication	1	d	NOEC		12000	PSM database
Pseudomonas putida	cell multiplication	1	d	EC10		20000	PSM database
Pseudomonas putida	cell multiplication	1	d	EC50		170000	PSM database
Algae							
Chlorella pyrenoidosa	cell multiplication	0	d	EC50		220000	PSM database

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Mecoprop DMA salt 66423-09-4							
Fish							
Lepomis macrochirus	mortality	4	d	LC50	>	100000	PSM database
Oncorhynchus mykiss	mortality	3	d	LC50	>	150000	PSM database
Oncorhynchus mykiss	mortality	4	d	LC50	>	150000	PSM database
Oncorhynchus mykiss	spasms, decolouration	3	d	NOEC		68100	PSM database

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Metazachlor

2-chloro-*N*-(2,6-dimethylphenyl)-*N*-(1*H*-pyrazol-1-ylmethyl)acetamide
CAS Number: 67129-08-2

Quality Target

Protected Asset	Water (µg/l)
Aquatic Communities	0.4
Drinking Water Supply	0.1

1. General

Metazachlor is a selective herbicide from the group of amides. If applied as a pre-emergence herbicide it is absorbed through the root system of germinating weed, as a post-emergence herbicide it is absorbed through the leaves. Metazachlor inhibits germination. Soil moisture enhances the effect. Metazachlor is mainly applied to control grass weed and weed in rape, cabbage and turnips.
Pesticides containing the active ingredient metazachlor are authorized in Germany (BBA, 1998).

2. Aquatic Communities

Results from long-term tests to assess the ecotoxicological effects are available for bacteria, algae, crustaceans and fish. The most sensitive test results are listed in section 4. The lowest value from longer-term tests was recorded for algae (Pseudokirchneriella subcapitata) with an NOEC of 3.6 µg/l.
The quality target for aquatic communities was derived by multiplying the EC10 of the most sensitive algae species by the compensation factor F1 = 0.1.
(QT = 3.6 µg/l x 0.1 = 0.36 µg/l, rounded 0.4 µg/l). The quality target for metazachlor is 0.4 µg/l.

The lowest active value was recorded for the metazachlor metabolite BH 479-4 with an NOEC of 80 µg/l for algae (Ankistrodesmus bibraianus). Therefore, the metabolite cannot be regarded as more toxic. The factor F2 is not applied because the metabolite is covered by the normally derived quality target for the stroma.

3. Drinking Water Supply

The maximum value of 0.1 µg/l determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is 0.1 µg/l.

4. Test Results

Species	Effect	Time		Value	Conc. [µg/l]	Reference
Metazachlor						
67129-08-2						
Bacteria						
Pseudomonas putida	no data	1	d	NOEC	23000	PSM database 1988
Pseudomonas putida	no data	1	d	EC50	176000	PSM database 1988
Algae						
Chlorella fusca	growth	1	d	EC50	58	Faust et al. 1993
Chlorella fusca	no data	4	d	NOEC	340	PSM database 1988
Chlorella fusca	no data	4	d	EC50	1630	PSM database 1988
Pseudokirchneriella subcapitata	biomass	3	d	EC 10	3.6	PSM database 1998
		3	d	EC 50	16.2	
	growth rate	3	d	EC 10	6.1	PSM database 1998
		3	d	EC 50	31.8	
Crustaceans						
Daphnia magna	reproduction	21	d	EC0	6250	PSM database 1990
Daphnia magna	immobilization	2	d	NOEC	10000	PSM database 1979
Daphnia magna	immobilization	2	d	EC50	22300	PSM database 1979
Fish						
Oncorhynchus mykiss	no data	28	d	NOEC	2150	PSM database 1990
Oncorhynchus mykiss	no data	4	d	LC5	2780	PSM database 1979
Oncorhynchus mykiss	no data	4	d	LC50	4420	PSM database 1979
Cyprinus carpio	no data	4	d	NOEC	10000	PSM database 1980
Cyprinus carpio	no data	4	d	LC50	15000	PSM database 1979
Cyprinus carpio	no data	4	d	LC50	22000	PSM database 1980
Metabolite BH 479-4						
Algae						
Ankistrodesmus bibraianus	no data	3	d	NOEC	80	PSM database 1991

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Additive effects of herbicide combinations on aquatic non-target organisms.
The Science of the Total Environment, Supplement 1993 Elsevier Science Publishers B. V., Amsterdam, 941-952

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www.bba.de, Phytomed-Datenbank
Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

PSM-Datenbank (PSM database),
Umweltbundesamt (Federal Environmental Agency), Berlin

Methabenzthiazuron

N-2-benzothiazolyl-*N,N'*-dimethylurea
CAS Number: 18691-97-9

Quality Target

Protected Asset	Water (µg/l)
Aquatic Communities	2.0
Drinking Water Supply	0.1

1. General

Methabenzthiazuron is a selective herbicide from the group of urea derivatives. It is mainly absorbed through the roots and to a lesser extent through the leaves. It inhibits the Hill reaction. The substance is primarily used to control broad-leaved weed and grass. Pesticides containing the active ingredient methabenzthiazuron are not authorized in Germany (BBA, 1998).

2. Aquatic Communities

Results from longer-term tests to assess the ecotoxicological effects are available for algae, crustaceans and fish. No data are available for bacteria. Due to the mode of action it is assumed that tests on bacteria are not relevant to the derivation of quality targets. The most sensitive test results are listed in section 4. The lowest value from long-term tests was recorded for algae (Scenedesmus subspicatus) with an NOEC of 18 µg/l.

The quality target for aquatic communities was derived by multiplying the NOEC of the most sensitive algae species by the compensation factor F1 = 0.1.
(QT = 18 µg/l x 0.1 = 1.8 µg/l, rounded 2.0 µg/l). The quality target for methabenzthiazuron is 2.0 µg/l.

3. Drinking Water Supply

The maximum value of 0.1 µg/l determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is 0.1 µg/l.

4. Test Results

Species	Effect	Time	Value	Conc. [µg/l]	Reference
Methabenzthiazuron					
18691-97-9					
Algae					
Scenedesmus subspicatus	no data	4 d	NOEC	18	PSM database 1985
Scenedesmus subspicatus	no data	4 d	LOEC	32	PSM database 1985
Scenedesmus subspicatus	biomass	4 d	EC50	42	PSM database 1985
Chlorella fusca	growth	1 d	EC50	44	Faust et al. 1993
Scenedesmus subspicatus	growth	4 d	EC50	119	PSM database 1985
Crustaceans					
Daphnia magna	reproduction	14 d	EC50	600	PSM database 1989
Daphnia magna	no data	21 d	NOEC	2000	PSM database 1989
Daphnia magna	reproduction	21 d	EC50	3800	PSM database 1989
Daphnia magna	no data	21 d	LOEC	6300	PSM database 1989
Daphnia magna	no data	21 d	EC50	6300	PSM database 1989
Fish					
Oncorhynchus mykiss	no data	21 d	NOEC	110	PSM database 1989
Oncorhynchus mykiss	no data	21 d	NOEC	190	PSM database 1989
Oncorhynchus mykiss	no data	21 d	LOEC	610	PSM database 1989
Blue-green algae					
Microcystis aeruginosa	growth		TC	42	Bringmann & Kühn 1975

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The Science of the Total Environment, Supplement 1993 Elsevier Science Publishers B. V., Amsterdam, 941-952

PSM-Datenbank (PSM database),
Umweltbundesamt (Federal Environmental Agency), Berlin

Metolachlor

2-chloro-*N*-(2-ethyl-6-methylphenyl)-*N*-(2-methoxy-1-methylethyl)acetamide
CAS Number: 51218-45-2

Quality Target

Protected Asset	Water (µg/l)
Aquatic Communities	0.2
Drinking Water Supply	0.1

1. General

Metolachlor is a selective ground herbicide from the group of amides. When applied to grass, the active ingredient enters the plant through the sprout located next to the seed; if applied to dicotyledonous species it is absorbed through the sprout and roots and passed on through the xylem. Metolachlor inhibits germination and is mainly used to control weedy grass, especially millet species.
Pesticides containing the active ingredient metolachlor are authorized in Germany (BBA, 1998).

2. Aquatic Communities

Results from long-term tests to assess the ecotoxicological effects are available for algae, crustaceans and fish. For bacteria no test results are available except from the metolachlor metabolite CGA 40172. Due to the mode of action it is assumed that tests on bacteria are not relevant to the derivation of quality targets. The lowest value from long-term tests was recorded for algae (*Scenedesmus subspicatus*) with an NOEC of 2 µg/l. Fish and crustaceans are less sensitive to metolachlor.

The quality target for aquatic communities was derived by multiplying the NOEC of the most sensitive algae species by the compensation factor F1 = 0.1.
(QT = 2 µg/l x 0.1 = 0.2 µg/l). The quality target for metolachlor is 0.2 µg/l.

3. Drinking Water Supply

The maximum value of 0.1 µg/l determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is 0.1 µg/l.

4. Test Results

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Metolachlor							
51218-45-2							
Algae							
Scenedesmus subspicatus	biomass	3	d	NOEC		2	PSM database 1985
Selenastrum capricornutum	no data	5	d	EC50		10	EPA 1995
Scenedesmus subspicatus	biomass	3	d	EC50		50	PSM database 1985
Scenedesmus subspicatus	no data	3	d	LC50		100	BBA 1993
Scenedesmus subspicatus	no data	5	d	LOEC		120	PSM database 1980
Crustaceans							
Daphnia magna	no data	21	d	LOEC	>	520	EPA 1995
Daphnia magna	reproduction	21	d	NOEC		600	BBA 1993
Daphnia magna	reproduction	21	d	NOEC		600	PSM database 1989
Daphnia magna	reproduction	21	d	LOEC		3000	BBA 1993
Daphnia magna	reproduction	21	d	LOEC		3000	PSM database 1989
Daphnia magna	reproduction	21	d	NOEC		3000	PSM database 1989
Fish							
Oncorhynchus mykiss	no data	28	d	NOEC		100	PSM database
Oncorhynchus mykiss	mortality	21	d	NOEC		250	BBA 1993
Oncorhynchus mykiss	mortality	21	d	NOEC		250	PSM database 1990
Oncorhynchus mykiss	mortality	21	d	LC20		653	PSM database 1990
Pimephales promelas	mortality	34	d	NOEC		780	PSM database 1978
Oncorhynchus mykiss	mortality	21	d	LOEC		1000	BBA 1993
Oncorhynchus mykiss	mortality	21	d	LOEC		1000	PSM database 1990
Oncorhynchus mykiss	mortality	21	d	LC50		1230	PSM database 1990
Pimephales promelas	no data	35	d	LOEC		1600	EPA 1995
Pimephales promelas	mortality	34	d	LOEC		1600	PSM database 1978
Oncorhynchus mykiss	mortality	21	d	LC80		2309	PSM database 1990
Plants							
Lemna gibba	no data	14	d	EC50		50	EPA 1995

Species	Effect	Time	Value	Conc. [µg/l]	Reference
Metabolite CGA 40172					
Bacteria					
Sewage sludge bacteria	no data		EC20	100000	PSM database 1991

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U.S. EPA, Office of Pesticide Programs, 1995
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Environmental Fate and Effects Division, U.S. EPA, Washington, D.C.

U.S. EPA, IRIS (Integrated Risk Information System), 1996
Silver Platter Information, Chem-Bank

Parathion-ethyl
CAS Number: 56-38-2

Quality Target

Protected Asset	Water (µg/l)
Aquatic Communities	0.005
Drinking Water Supply	0.1

1. General

Parathion-ethyl is a organophosphorus compound that inhibits choline esterase. It is used as an insecticide, acaricide and nematocide. Paraxon, one of its metabolites, severely inhibits choline esterase. Photoisomerization generates an S-ethyl parathion of which the effect on aquatic organisms has not been tested and can therefore not be assessed. Parathion-ethyl is suspected to affect the reproductive capability and the endocrine system (*UBA-Texte 65/95*). Pesticides containing the active ingredient parathion-ethyl are authorized in Germany (BBA, 1998).

2. Aquatic Communities

NOEC values from longer-term tests to assess the ecotoxicological effects are available for bacteria, algae, crustaceans and fish. There is a study describing parathion-ethyl as highly toxic to insects. However, that study is not consistently plausible.

The quality target for aquatic communities was derived by multiplying the NOEC (21 d) for Daphnia magna (0.05 µg/l) by the compensation factor F1 = 0.1.
(QT = 0.05 µg/l x 0.1 = 0.005 µg/l). The quality target for parathion-ethyl is 0.005 µg/l.

3. Drinking Water Supply

The maximum value of 0.1 µg/l determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is 0.1 µg/l.

4. Test Results

4.1 Aquatic Toxicity

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Parathion-ethyl 56-38-2							
Bacteria							
Bacteria biocenosis	inhibition of glucose uptake	60	min	EC 10		1000	Matthias 1990
Bacteria biocenosis	inhibition of glucose uptake	60	min	EC 50		4500	Matthias 1990
Photobacterium phosphoreum	inhibition of light emission	30	min	EC 10		2000	Matthias 1990
Photobacterium phosphoreum	inhibition of light emission	30	min	EC 50		24000	Matthias 1990
Photobacterium phosphoreum (Microtox)	inhibition of light emission	5	min	EC 50		8500	Somasundaram 1990
Pseudomonas putida	cell multiplication	16	h	EC 3	>	1000	Bringmann et al. 1977
Algae							
Microcystis aeruginosa	cell multiplication	8	d	EC 3		34	Bringmann et al. 1978
Scenedesmus quadricauda	cell multiplication	8	d	EC 3		390	Bringmann et al 1978
Scenedesmus subspicatus	growth rate	4	d	EC 50		500	PSM database
Scenedesmus subspicatus	inhibition of O_2 production	3	d	EC 10		1200	Matthias 1990
Crustaceans							
Daphnia magna	mortality,	21	d	NOEC		0.05	Schiedsanalyse bga 1994
Daphnia magna	reproduction	21	d	NOEC		0.08	Spacie et al. 1981
Daphnia magna	mortality	21	d	LC 50		0.14	Spacie et al. 1981
Daphnia magna	immobilization	21	d	NOEC		0.2	Dortland 1980
Daphnia magna		1	d	EC 50		0.8	Frear & Boyd 1967
Daphnia magna	immobilization	2	d	EC 50		2.5	PSM database
Daphnia magna	immobilization	1	d	EC 50		0.1	PSM database
Daphnia magna	immobilization	1	d	EC 50		6.49	PSM database
Gammarus fasciatus	mortality	43	d	NOEC	<	0.04	Spacie 1976
Gammarus fasciatus	mortality	4	d	LC 50		0.4	Spacie 1976
Mysidopsis bahia		28	d	LOEC		0.01	US EPA 1995
Orconectes nais	mortality	4	d	LC 50		0.036	Sanders 1972
Oronectes nais	mortality	4	d	LC 50		0.04	Johnson & Finley 1980

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Fish							
Brachydanio rerio	larval length	7	d	NOEC		250	PSM database
Brachydanio rerio	larval length	7	d	LOEC		1000	PSM database
Lepomis macrochirus	growth, spawning, mortality (fry)	23	m	NOEC	>	3.2	Spacie et al. 1981
Lepomis macrochirus	mortality	6	d	LC 100		10	Weiss & Gakstatter 1964
Lepomis macrochirus	mortality	1	d	LC 50		56	PSM database
Leuciscus idus melanotus	no data	4	d	LC 0		270	PSM database
Salmo gairdneri	mortality	4	d	LC 50		1400	Van Leeuwen et al. 1985
Oncorhynchus mykiss	mortality	1	d	LC 50		2000	PSM database
Pimephales promelas	deformations, reproduction	8.5	m	NOEC		4	Spacie et al. 1981
Salvelinus fontinalis	growth, maturity, successful spawning,	9	m	NOEC		7	Spacie et al. 1981
Other Species and/or Parameters							
Crustaceans							
Crustacean population	abundance	190	d	NOEC		150	Dortland 1980
Fish							
Lepomis macrochirus	deformations	23	m	NOEC	>	0.17	Spacie et al. 1981
Lepomis macrochirus	AChE inhibition	30	d	TC		0.1	Weiss & Gakstatter 1964
Lepomis macrochirus	AChE inhibition	15	d	TC		1	Weiss & Gakstatter 1964
Carassius auratus	AChE inhibition	15	d	TC		1	Weiss & Gakstatter 1964
Insects							
Limnephilus bipunctatus	mortality	90	d	emergence rate		0.001	Schulz & Liess 1995

4.2 Bioaccumulation

Species	Effect	Time		Test	Value	Reference
Fish						
Lepomis macrochirus	residue	3	d	BCF	462	Spacie et al. 1981
Salvelinus fontinalis	residue	6	d	BCF	157-228	Spacie et al. 1981

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Parathion-methyl
CAS Number: 298-00-0

Quality Target

Protected Asset	Water (µg/l)
Aquatic Communities	0.02
Drinking Water Supply	0.1

1. General

Parathion-methyl is an organophosphorus compound. It is used as an insecticide and inhibits choline esterase. Parathion-methyl is prohibited in agriculture, fruit culture and viniculture because of its toxicity to ground invertebrates. It is still used in cereal farming where an application rate limit is applied (BBA/0088/93/03). Pesticides containing the active ingredient parathion-methyl are authorized in Germany (BBA, 1998).

2. Aquatic Communities

NOEC values from longer-term tests to assess the ecotoxicological effects are available for bacteria, algae, crustaceans and fish. Crustaceans are the most sensitive species to parathion-methyl.

The quality target for aquatic communities was derived by multiplying the NOEC (21 d) for Daphnia magna (0.18 µg/l) by the compensation factor F1 = 0.1.
(QT = 0.18 µg/l x 0.1 = 0.018 µg/l, rounded 0.02 µg/l). The quality target for parathion-methyl is 0.02 mg/l.

3. Drinking Water Supply

The maximum value of 0.1 µg/l determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is 0.1 µg/l.

4. Test Results

4.1 Aquatic Toxicity

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Parathion-methyl 298-00-0							
Bacteria							
Pseudomanas putida	cell multiplication	18	h	EC 10	>	34000	Trenel et al. 1982
Algae							
Chlorella reinhardi	cell multiplication	4	d	NOEC		220	Schäfer et al. 1994
Chlorella reinhardi	cell multiplication	7	d	NOEC		830	Schäfer et al. 1994
Chlorella reinhardi	cell multiplication	10	h	NOEC		1450	Schäfer et al. 1994
Chlorella reinhardi	cell multiplication	3	d	NOEC	>	100000	Schäfer et al. 1994
Chlorella vulgaris	no data	4	d	EC 50		5300	BBA./0088/93/03
Scenedesmus subspicatus	cell multiplication	7	d	EC 3		2600	Trenel et al. 1982
Scenedesmus subspicatus	cell multiplication	4	d	NOEC		100	PSM database
Scenedesmus subspicatus	cell multiplication	4	d	EC 50		3000	PSM database
Scenedesmus subspicatus	cell multiplication	3	d	NOEC		8000	Schäfer et al. 1994
Scenedesmus subspicatus	cell multiplication	3	d	EC 50		15000	Schäfer et al. 1994
Crustaceans							
Daphnia magna	reproduction	21	d	NOEC		0.18	PSM database
Daphnia magna	mortality	21	d	LOEC		0.56	PSM database
Daphnia magna	immobilization, reproduction	21	d	NOEC		1.2	Dortland. 1980
Daphnia magna	mortality	2	d	LC 50		8.0	Dortland. 1980
Daphnia magna	immobilization	2	d	EC 50		0.14	Johnson & Finley 1980
Daphnia magna	mortality	2	d	LC 50		0.14	Mayer & Ellersieck 1986
Daphnia magna	no data	2	d	NOEC		3.2	PSM database
Daphnia magna	no data	2	d	LOEC		5.6	PSM database
Daphnia magna	mortality	2	d	LC 50		7.3	PSM database
Daphnia magna	mortality	2	d	LC 50		12	Oikari et al. 1992
Daphnia magna	immobilization	1	d	EC 50		4.6	Trenel et al. 1982
Daphnia magna		1	d	LC 50		4.8	Frear & Boyd 1967
Daphnia magna				LC 50		4.8	Kenaga 1979
Gammarus fasciatus	immobilization	4	d	EC 50		3.8	Johnson & Finley 1980
Mysidopsis bahia	mortality	4	d	MATC		0.11	Nimmo et al. 1981

Species	Effect	Time	Value	Conc. [µg/l]	Reference
Neomysis mercedis	mortality	4 d	LC 50	0.2	Brandt et al. 1993
Portumus trituberculatus	mortality	1 d	LC 50	0.17	Hirayama & Tamaoi 1980
Procambarus acutus	mortality	2 d	LC 50	2.4	PSM database, BBA
Procambarus acutus acutus	mortality	4 d	LC 50	3	Carter & Graves 1972
Palaemonetes kadiakensis	mortality	1 d	LC 50	2.5	Naquvi & Ferguson 1970
Simocephalus serrulatus	immobilization	2 d	EC 50	0.37	Johnson & Finley. 1980
Fish					
Carassius auratus	no data	4 d	LC 50	9000	PSM database, BBA
Channa punctuatus	mortality	2 d	LC 50	5.33	Bhattacharya 1993
Gambusia affinis	mortality	4 d	LC 50	5	Carter & Graves 1972
Heteropneustes fossilis	mortality	4 d	LC 50	7000	Singh & Srivastava 1982
Heteropneustes fossilis	mortality	3 d	LC 50	8000	Singh & Srivastava 1982
Heteropneustes fossilis	mortality	2 d	LC 50	8600	Singh & Srivastava 1982
Heteropneustes fossilis	mortality	1 d	LC 50	9400	Singh & Srivastava 1982
Hypophthalmichthys molitrix	mortality	1 d	LC 50	5.2	Maheshwari et al. 1988
Lepomis macrochirus	physiological effects	42 d	EC	60	Auwarter 1977
Lepomis macrochirus		21 d	EC	60	Auwarter 1977
Leuciscus idus melanotus		4 d	NOEC	4800	PSM database
Leuciscus idus melanotus	mortality	4 d	LC 50	6900	PSM database
Oncorhynchus mykiss		21 d	NOEC	56	PSM database
Oncorhynchus mykiss	mortality	21 d	LC 50	2040	PSM database
Oncorhynchus mykiss		4 d	NOEC	1400	PSM database
Oncorhynchus mykiss	mortality	4 d	LC 50	2700	PSM database
Oncorhynchus mykiss	mortality	1 d	LC 50	7000	PSM database, Literatur
Pimephales promelas Embryo-Larval-Test	mortality	32 d	NOEC	380	Jarvinen et al. 1982
Pimephales promelas embryonic larval test	growth (biomass)	32 d	NOEC	310	Jarvinen et al. 1982
Tilapia mossambica	mortality	2 d	LC 50	266	Rao & Rao 1983
Salmo clarki	mortality	4 d	LC 50	1850	PSM database, BBA

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Other Species and/or Parameters							
Algae							
Phytoplankton	cell multiplication	90	d	NOEC		> 150 < 300	Pal & Konar 1990
Crustaceans							
Daphnia magna	filtration (µl/ind/h)	5	h	EC 50		0.000075	Fernández-Casalderrey et al. 1993
Daphnia magna	food uptake (cell/ind/h)	5	h	EC 50		0.000089	Fernández-Casalderrey et al. 1993
Fish							
Lepomis macrochirus	AChE inhibition	30	d	TC		1	Weiss & Gakstatter 1964
Lepomis macrochirus	AChE inhibition	15	d	TC		10	Weiss & Gakstatter 1964
Lepomis macrochirus	behaviour	4	d	TC		3	Henry & Atchinson 1984
Tilapia mossambica	enzyme activity (phosphorylase, aldolase)	2	d	TC		90	Rao & Rao 1983
Insects							
Chaoborus crystallinus	mortality	21	d	NOEC	<	0.25	Dortland 1980
Cules tritaeniorhynchus	mortality	1	d	LC 50		0.54	Shim & Self 1973

4.2 Bioaccumulation

Species	Effect	Time		Test	Value	Reference
Fish						
Oncorhynchus mykiss	residue	14	h	BCF	12-71	Crossland & Bennett 1984

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Environ. Toxicol. Chem. 3: 399-408

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Prometryn

N,N'-bis(1-methylethyl)-6-(methylthio)-1,3,5-triazine-2,4-diamine
CAS Number: 7287-19-6

Quality Target

Protected Asset	Water (µg/l)
Aquatic Communities	0.5
Drinking Water Supply	0.1

1. General

Prometryn is a selective systemic herbicide from the group of triazine derivatives. It inhibits photosynthesis and is absorbed through the leaves and roots. Once in the plant, it moves acropetally through the xylem.
Pesticides containing the active ingredient prometryn are not authorized in Germany (BBA, 1998).

2. Aquatic Communities

Results from longer-term tests to assess the ecotoxicological effects are available for bacteria, algae, crustaceans and fish. The most sensitive test results are listed in section 4. The lowest value was recorded for algae (Ankistrodesmus falcatus) with an NOEC of 5 µg/l. In a comparison, macrophytes showed a similar sensitivity.

The quality target for aquatic communities was derived by multiplying the value of the most sensitive alga species by the compensation factor F1 = 0.1.
(QT = 5 µg/l x 0.1 = 0.5 µg/l). The quality target for prometryn is 0.5 µg/l.

3. Drinking Water Supply

The maximum value of 0.1 µg/l determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is 0.1 µg/l.

4. Test Results

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Prometryn							
7287-19-6							
Bacteria							
Pseudomonas putida		3	d	NOEC		11250	Bruns & Knacker 1998
Rhizobium japonicum	growth	26.25	h	TC	≤	6.8	Yee et al. 1985
Algae							
Chlamydomonas segnis	growth	14	h	TC	≤	0.75	Yee et al. 1985
Navicula pelliculosa	no data	5	d	EC50		1	EPA 1995
Ankistrodesmus falcatus	growth	12	d	NOEC		5	Tscheu-Schlüter 1976
Ankistrodesmus falcatus	growth	12	d	LOEC		8	Tscheu-Schlüter 1976
Ankistrodesmus falcatus	growth	12	d	EC50		20	Tscheu-Schlüter 1976
Plankton	assimilation	3	h	EC50		22	Brown & Lean 1995
Crustaceans							
Daphnia magna	immobilization	2	d	EC50		9700	Marchini et al. 1988
Daphnia magna	reproduction	21	d	LOEC		2000	EPA 1995
Fish							
Penaeus duorarum	mortality	2	d	LC50	>	1000	EPA 1995
Pimephales promelas	no data	28	d	LOEC		1200	EPA 1995
Daphnia magna	no data	21	d	LOEC		2000	EPA 1995
Plants							
Lemna gibba	no data	14	d	EC50		11.8	EPA 1995

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In Vitro Effects of the s-Triazine Herbizide, Prometryn, on the Growth of Terrestrial and Aquatic Microflora.
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Simazine
CAS Number: 122-34-9

Quality Target

Protected Asset	Water (µg/l)
Aquatic Communities	0.1
Drinking Water Supply	0.1

1. General

Simazine is a herbicide from the group of triazine derivatives and inhibits photosynthesis. Pesticides containing the active ingredient simazine are authorized in Germany (BBA, 1998). Triazine herbicides are suspected to affect the reproductive capability and the endocrine system (*UBA-Texte 65/95*).

2. Aquatic Communities

Acute data and NOEC values from longer-term tests to assess the ecotoxicological effects are available for algae, crustaceans and fish. For bacteria only acute data are available. Algae proved to be the most sensitive organisms with regard to simazine.

The normal case quality target for aquatic communities was derived by multiplying the lowest NOEC (11 µg/l) for Scenedesmus subspicatus by the compensation factor F1 = 0.1. As much lower acute data for algae sensitivity have been observed (US EPA, 1995), the compensation factor F2 = 0.1 is applied as well:
(QT = 11 µg/l x 0.1 x 0.1 = 0.11 µg/l, rounded 0.1 µg/l). The quality target for simazine is 0.1 µg/l.

3. Drinking Water Supply

The maximum value of 0.1 µg/l determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is 0.1 µg/l.

4. Test Results

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Simazine 122-34-9							
Bacteria							
Bacteria (6 species)	cell multiplication	1	d	TC	>	3000	Beckmann et al. 1984
Photobacterium phosphoreum	bioluminescence (Microtox)	5	min	EC 50		238300	McFeters et al. 1983
Pseudomonas putida	no inhibition					400	KBwS 1988
Algae							
Anabaena flosaquae		5	d	EC 50		0.04	US EPA 1995
Ankistrodesmus minutissimus	cell multiplication	14	d	LC 50		87	Bednarz 1981
Clorococcus sp.	cell multiplication	14	d	LC 50		8	Bednarz 1981
Navicula pelliculosa		5	d	EC 50		0.09	US EPA 1995
Scenedesmus acutus	cell multiplication	14	d	LC 50		65	Bednarz 1981
Scenedesmus quadricauda	cell multiplication	14	d	LC 50		400	Bednarz 1981
Scenedesmus subspicatus	biomass	3	d	NOEC		11	PSM database
Scenedesmus subspicatus	biomass	3	d	EC 50		42	PSM database
Selenastrum capricornutum	biomass	14-21	d	EC 50		0.614	Turbak et al. 1986
Selenastrum capricornutum		5	d	EC 50		0.1	US EPA 1995
Crustaceans							
Daphnia magna	reproduction	21	d	NOEC		36	PSM database
Daphnia magna	immobilization, reproduction	21	d	NOEC		140	PSM database
Daphnia magna	immobilization	21	d	EC 50		290	PSM database
Daphnia magna	immobilization	2	d	EC 0		58000	PSM database
Daphnia magna	immobilization	2	d	EC 50	>	100000	PSM database
Daphnia magna	immobilization	1	d	EC 0	>	100000	PSM database
Daphnia magna	immobilization	2	d	EC 50		1100	Johnson & Finley 1980
Daphnia magna	immobilization	2	d	EC 50		1000	Sanders 1970
Daphnia pulex	reproduction, moulting	26	d	NOEC	<	4000	Fitzmayer et al. 1982a
Daphnia pulex		2	d	LC 50		92100	Fitzmayer et al. 1982b
Heliodiaptimus viduus	mortality	51	h	LC100		1000	Georg et al. 1982
Neopanope texana	no data	4	d	NOEC		1000000	PSM database
Penaeus duorarum	no data	4	d	NOEC		75000	PSM database

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Penaeus duorarum	no data	4	d	EC 50		113000	PSM database
Penaeus duorarum	no data	1	d	EC 50		452000	PSM database
Fish							
Cyprinus carpio	mortality	4	d	LC 50	>	100000	PSM database
Cyprinus carpio	no data	4	d	NOEC	≥	34000	PSM database
Cyprinus carpio	mortality	4	d	LC 50	>	34000	PSM database
Ictalurus melas	mortality	4	d	LC 50		65000	PSM database
Ictalurus melas	mortality	2	d	LC 50		80000	PSM database
Leuciscus idus melanotus	mortality	4	d	LC 50		90000	PSM database
Leuciscus idus melanotus	mortality	2	d	LC 50	>	100000	PSM database
Oncorhynchus mykiss	growth rate	21	d	NOEC		3200	PSM database 1989
Oncorhynchus mykiss	growth rate	21	d	LOEC		5800	PSM database 1989
Oncorhynchus mykiss	mortality	21	d	NOEC		10000	PSM database 1989
Oncorhynchus mykiss	mortality	21	d	LOEC		18000	PSM database 1989
Oncorhynchus mykiss	no data	4	d	NOEC		10000	PSM database 1983
Oncorhynchus mykiss	mortality	4	d	LC 100	>	100000	PSM database
Oncorhynchus mykiss	mortality	4	d	LC 50		70500	PSM database 1976
Oncorhynchus mykiss	no data	4	d	NOEC	<	12000	PSM database 1976
Oncorhynchus mykiss	mortality	48		LC 50		56000	PSM database
Poecilia reticulata	mortality	96	d	LC 50		48000	PSM database
Punctius ticto	mortality	30	d	LC 50		1000	Upadhyaya & Rao 1980
Punctius ticto	mortality	16	d	LC 50		5000	Upadhyaya & Rao 1980
Roccus saxatilis	mortality	4	d	LC 50		312.5[1]	Wellborne 1969
Roccus saxatilis	mortality	2	d	LC 50		550[1]	Wellborne 1969
Roccus saxatilis	mortality	1	d	LC 50		750[1]	Wellborne 1969
Salmo gairdneri	mortality	28	d	NOEC	≥	2500	Bathe et al. 1975
Salmo gairdneri	mortality	4	d	LC 50	>	100000	Bathe et al. 1975
Salmo gairdneri	mortality	2	d	LC 50		85000	Alabaster 1969
Other Species and/or Parameters							
Macrophytes							
Lemna minor	cell membrane permeability	12	h	TC		2000	O'Brian & Prendeville 1979
Lemna gibba		14	d	EC 50		0.14	US EPA 1995

[1] converted from 80 % to 100 % active ingredient

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Terbuthylazine

6-chloro-*N*-(1,1-dimethylethyl)-*N'*-ethyl-1,3,5-triazine-2,4-diamine
CAS Number: 5915-41-3

Quality Target

Protected Asset	Water (µg/l)
Aquatic Communities	0.5
Drinking Water Supply	0.1

1. General

Terbuthylazine is a herbicide from the triazine chemical family. It is mainly absorbed through the roots and to a lesser extent through the leaves. Terbuthylazine inhibits the Hill reaction. The substance is primarily used as a pre- and post-emergence herbicide to control dicotyledonous weed in maize, potatoes, peas and cereals. It is also used in viniculture and fruit farming.
Pesticides containing the active ingredient terbuthylazine are authorized in Germany (BBA, 1998).

2. Aquatic Communities

Results from long-term tests to assess the ecotoxicological effects are available for bacteria, algae, crustaceans and fish. The most sensitive test results are listed in section 4. The lowest value was recorded for crustaceans (Daphnia magna) where one NOEC value was below 5.4 µg/l.
The quality target for aquatic communities was derived by multiplying the NOEC of the most sensitive crab species by the compensation factor F1 = 0.1.
(QT = 5.4 µg/l x 0.1 = 0.54 µg/l, rounded QT = 0.5 µg/l). The quality target for terbuthylazine is 0.5 µg/l.

3. Drinking Water Supply

The maximum value of 0.1 µg/l determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is 0.1 µg/l.

4. Test Results

Species	Effect	Time	Value		Conc. [µg/l]	Reference
Terbutylhazine						
5915-41-3						
Bacteria						
Pseudomonas putida	cell multiplication	3 d	NOEC		4000	Bruns & Knacker 1998
Algae						
Scenedesmus subspicatus	no data	5 d	NOEC		9.6	PSM database 1982
Plankton	growth	10 d	TC	≤	20	Shehata et al. 1993
Crustaceans						
Daphnia magna	reproduction	21 d	NOEC	<	5.4	BBA 1993
Daphnia magna	reproduction	21 d	LOEC		13	BBA 1993
Daphnia magna	reproduction	21 d	NOEC		18	PSM database
Daphnia magna	reproduction	21 d	LOEC		55	PSM database
Mysidopsis bahia	mortality	4 d	LC50		110	EPA 1995
Daphnia magna	immobilization	21 d	NOEC		210	PSM database 1989
Daphnia magna	mobility	21 d	LOEC		210	PSM database
Daphnia magna	mobility	21 d	NOEC		210	PSM database
Daphnia magna	no data	2 d	NOEC	<	10000	PSM database 1977
Daphnia magna	no data	2 d	EC50		21200	PSM database 1977
Fish						
Oncorhynchus mykiss	no data	21 d	NOEC		238	PSM database 1990
Oncorhynchus mykiss	no data	21 d	LOEC		950	PSM database 1990
Poecilia reticulata	no data	4 d	LC50		1600	PSM database

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Triazophos
O,O-diethyl *O*-(1-phenyl-1*H*-1,2,4-triazol-3-yl) phosphorothioate
CAS Number: 5915-41-3

Quality Target

Protected Asset	Water (µg/l)
Aquatic Communities	0.03
Drinking Water Supply	0.1

1. General

Triazophos is a broadly active insecticide, acaricide and nematocide from the group of phosphoric acid esters. It acts as a poison on contact and oral consumption. Triazophos inhibits choline esterase. It is mainly applied to control biting and sucking insects in vegetable and fruit farming, agriculture and ornamental plant culture.
Pesticides containing the active ingredient triazophos are authorized in Germany (BBA, 1998).

2. Aquatic Communities

Results from longer-term tests to assess the ecotoxicological effects are available for algae, crustaceans and fish. No test data are available for bacteria. Due to the mode of action it is assumed that tests on bacteria are not relevant to the derivation of quality targets. The most sensitive test results are listed in section 4. The lowest value was recorded for crustaceans (Daphnia magna) with an NOEC of 0.32 µg/l. Fish showed a comparable sensitivity.

The quality target for aquatic communities was derived by multiplying the NOEC of the most sensitive crab species by the compensation factor F1 = 0.1.
(QT = 0.32 µg/l x 0.1 = 0.032 µg/l, rounded QT = 0.03 µg/l). The quality target for triazophos is 0.03 µg/l.

3. Drinking Water Supply

The maximum value of 0.1 µg/l determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is 0.1 µg/l.

4. Test Results

Species	Effect	Time	Value	Conc. [µg/l]	Reference
Triazophos 24017-47-8					
Algae					
Scenedesmus subspicatus	growth	4 d	NOEC	100	PSM database 1984
Scenedesmus subspicatus	growth	4 d	NOEC	100	PSM database 1984
Scenedesmus subspicatus	cell multiplication	4 d	EC10	280	PSM database 1984
Scenedesmus subspicatus	cell multiplication	4 d	EC50	1150	PSM database 1984
Crustaceans					
Daphnia magna	reproduction	21 d	NOEC	0.32	PSM database 1990
Daphnia magna	immobilization	21 d	EC 100	1	PSM database 1990
Fish					
Oncorhynchus mykiss	no data	21 d	NOEC	0.5	PSM database 1989
Oncorhynchus mykiss	no data	21 d	LC50	10	PSM database 1989

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PSM-Datenbank (PSM database),
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Trifluralin
CAS Number: 1582-09-8

Quality Target

Protected Asset	Water (µg/l)
Aquatic Communities	0.03
Drinking Water Supply	0.1

1. General

Trifluralin is an aniline derivative and serves as a ground herbicide on cereals, beets, rape, cabbage and sunflowers. Pesticides containing the active ingredient trifluralin are authorized in Germany (BBA, 1998).

2. Aquatic Communities

NOEC data or similar subchronic and chronic results from longer-term tests to assess the ecotoxicological effects are available for algae, crustaceans and fish. No data are available for bacteria. The derivation of a quality target to protect aquatic communities is based on the assumption that bacteria do not represent the most sensitive species group. The most sensitive among the tested species were fish (Pimephales promelas, 35 d, NOEC = 0.3 µg/l).

The quality target for aquatic communities was derived by applying the compensation factor F1 = 0.1.
(QT = 0.3 µg/l x 0.1 = 0.03 µg/l). The quality target for trifluralin is 0.03 µg/l.

3. Drinking Water Supply

The maximum value of 0.1 µg/l determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is 0.1 µg/l.

4. Test Results

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Trifluralin							
1582-09-8							
Algae							
Chlorococcum sp	oxygen production	1	h	EC 50	>	100000	Walsh 1972
Dunaliella tertiolecta	oxygen production	1	h	EC 50	>	100000	Walsh 1972
Isochrysis galbana	oxygen production	1	h	EC 50	>	100000	Walsh 1972
Phaeodactylum tricornutum	oxygen production	1	h	EC 50	>	100000	Walsh 1972
Oedogonium sp.	biomass	6	w	EC 50		100	Bulcke & Stryckers 1977
Selenastrum carpricornutum	number of cells	4	d	ErC50		12.2	PSM database
Selenastrum carpricornutum	growth rate	4	d	ED 10		8 12	PSM database
Selenastrum carpricornutum	biomass	7	d	EC 50		10 38	PSM database
Selenastrum carpricornutum	biomass	7	d	EC 10		4.58	PSM database
Selenastrum carpricornutum	biomass	7	d	NOEC		5.37	PSM database
Crustaceans							
Alonella sp.	mortality	2	d	LC 50		60	Naqvi et al. 1985
Asellus brevicaudus	mortality	4	d	LC 50		1000	Sanders 1970
Cancer magister	mortality	50	d	TC100		220	Caldwell et al. 1979
Cancer magister	reproduction	1	d	NOEC	>	330	Caldwell 1977
Cancer magister	reproduction	69	d	NOEC		15	Caldwell 1977
Daphnia magna	mortality	2	d	LC 50		193	Macek et al. 1976
Daphnia magna	mortality	64	d	TC100		7.2	Macek et al. 1976
Daphnia magna	immobilization	2	d	EC 50		560	Johnson & Finley 1980
Daphnia magna	immobilization	2	d	EC 50		193	PSM database
Daphnia magna	immobilization	2	d	NOEC		56	PSM database
Daphnia magna	immobilization	21	d	LOEC		50.7	PSM database
Daphnia magna	immobilization and reproduction	21	d	NOEC		26.2	PSM database
Daphnia magna	survival rate	64	d	LOEC		7.2	PSM database
Daphnia magna	survival rate	64	d	NOEC		2.4	PSM database
Daphnia magna	mortality	2	d	LC 50		193	Macek et al.. 1976
Daphnia magna	mortality	64	d	TC100		7.2	Macek et al.. 1976
Daphnia pulex	immobilization	2	d	EC 50		240	Sanders & Cope 1966
Daphnia pulex	immobilization	2	d	EC 50		625	Johnson & Finley 1980
Diaptomus sp.	mortality	2	d	LC 50		80	Naqvi et al. 1985

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Diaptomus sp.	mortality	2	d	LC 50		80	Naqvi et al. 1985
Eucyclops sp.	mortality	2	d	LC 50		50	Naqvi et al. 1985
Gammarus fasciatus	mortality	2	d	LC 50		1000	Sanders 1970
Mysidopsis bahia	mortality	4	d	LC 50		136	Nimmo et al. 1981
Fish							
Carassius auratus	mortality	4	d	LC 50		585	Parka & Worth 1965
Carassius auratus	mortality	4	d	LC 50		145	Parka & Worth 1965
Cyprinodon variegatus	mortality	4	d	LC 50		190	Parrish et al. 1978
Cyprinodon variegatus	growth	166	d	LOEC		9	Parrish et al. 1978
Cyprinodon variegatus	reproduction	166	d	LOEC		5	Parrish et al. 1978
Cyprinodon variegatus	reproduction	166	d	MAT C	>	1	Parrish et al. 1978
Cyprinodon sp.	morphology	51	d	TC		16	Couch et al. 1979
Cyprinodon sp	morphology	28	d	TC		5	Couch et al. 1979
Gambusia affinis	mortality	4	d	LC 50		12000	Naqvi & Leung 1983
Gambusia affinis	behaviour	16	d	TC		30	Yockim et al. 1980
Ictalurus punctatus	mortality	4	d	LC 50		417	Mc Corkle et al. 1977
Lepomis cyanellus	mortality	8	d	TC 100		100	Reinbold 1974
Lepomis machrochirus	mortality	4	d	LC 50		47	Macek et al. 1969
Leuciscus idus melanatus	mortality	4	d	NOEC		100	PSM database
Micropterus salmoides	mortality	4	d	LC 50		75	Johnson & Finley 1980
Oncorhynchus mykiss	survival and behaviour	2	d	NOEC		1.14	PSM database
Oncorhynchus mykiss	mortality	4	d	LC 50		10	Cope 1965
Pimephales promelas	behaviour	35	d	NOEC		0.7	PSM database
Pimephales promelas	spinal column deformation	35	d	NOEC		0.3	PSM database
Pimephales promelas	mortality	4	d	LC 50		105	Johnson & Finley 1980
Salmo gairdneri	mortality	4	d	LC 50		41	Johnson & Finley 1980
Other Species and/or Parameters							
Amphibians							
Bufo woodhousi fowleri	mortality	1	d	LC 50		90	UNEP/IRPTC 1985
Insects							
Chironomus riparius	mortality	42	d	LC		4	Huckins et al. 1986

Species	Effect	Time	Value	Conc. [µg/l]	Reference
Chironomus riparius		2 d	EC 50	1000	Johnson 1986
Pteronarcys californica	mortality	4 d	LC 50	2800	Johnson & Finley 1980
Shells					
Mytilus edulis	mortality	4 d	LT 50	240	Liu & Lee 1975
Cochlea					
Semisulcospira libertina	mortality	2 d	LC 50	8000	Hashimoto & Nishiuchi 1981

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Tributyltin compounds

Quality Target

Protected Asset	Water (µg/l)
Aquatic Communities	0.0001
Drinking Water Supply	0.1

refers to tributyltin

1. General

Tributyltin compounds exist as active ingredients in antifouling paint. Their main mode of action is oxidative phosphorylation inhibition. Among the numerous tributyltin compounds (TBT compounds), tributyltin oxide (TBTO) is the most important. TBT compounds are used in antifouling paint and wood preservatives (also to replace PCP), as fungicides, algicides and molluscicides (to control cochlea as intermediate hosts of schistosomes). The use of tributyltin compounds in pesticides is not authorized in Germany (BBA, 1998).

2. Aquatic Communities

Results from longer-term tests to assess the ecotoxicological effects of TBT are available for bacteria, algae, crustaceans, fish, shells and cochlea. The toxic effect of TBT salts is caused by the TBT cation. Therefore, the test results of TBT compounds can be combined to derive a quality target. Unless otherwise indicated, the test results refer to tributyltin (TBT).

In the case of fish, the lowest valid NOEC was recorded for rainbow trout (Oncorhynchus mykiss) with 0.04 µg/l. The lowest effective threshold value for histopathological alterations was observed on fish (Poecilia reticulata, 90 d, NOEC 0.01 µg/l).

Marine organisms appear to be a little more sensitive than freshwater organisms. The hazardous concentration for 5% of the species (HC5), also known as the "maximum permissible concentration" (MPC), was assessed from the sensitivity distribution of the species. In a Dutch report (Crommentuijn et al. 1997), the MPC for freshwater organisms is reported to be 0.014 µg/l while the MPC for marine species is 0.001 µg/l. It is proposed that the concentration of 0.00014 µg/l for fresh water and 0.00001 µg/l for sea water can be considered negligible concentrations (Crommentuijn et al. 1997).
Among marine organisms, crustaceans (Acartia tonsa, larval development, 8 d, LOEC 0.001 µg/l) proved to be among the most sensitive species. Shells and cochlea were also very responsive. In the case of the prosobranchiates Hinia incrassata, Hinia reticulata and Nucella lapillus, the female animals developed male genitals (known as "imposex") even at very low TBT concentrations (Oehlmann et al. 1998). Nucella lapillus develops imposex even at levels between 0.001 and 0.003 µg/l (Matthiessen & Gibbs 1998). The lowest NOEC for the

reproduction of the snail *Buccininum undatum* was < 0.0083 µg/l. The NOEC values of the most sensitive shell species were recorded around < 0.005 µg/l.
The quality target for aquatic communities was derived by multiplying the effective threshold value for development inhibition of the crab Acartia tonsa (0.001 µg/l TBT) by the compensation factor F1 = 0.1. Therefore, the quality target for aquatic communities is 0.0001 µg/l TBT. The quality target refers to the TBT cation.

3. Drinking Water Supply

The maximum value of 0.1 µg/l determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is 0.1 µg/l.

4. Test Results

Species	Effect	Time		Value	Conc. [µg/l]	Reference
Tributyltin acetate 56-36-0						
Algae						
Porphyra yezoensis	growth	6	d	EC50	33	Maruyama et al. 1991
Skeletonema costatum	growth	3	d	EC50	0.360	Walsh et al. 1985
Thalassiosira guillardii	growth	3	d	EC50	1.280	Walsh et al. 1985
Aquatic plants						
Elodea sp.	growth	10	d	TC	30	Floch et al. 1964
Lemna media	growth	10	d	TC	150	Floch et al. 1964
Crustaceans						
Daphnia magna	mortality	15	d	TC100	5	Stroganov et al.1972
Fish						
Lebistes reticulatus	mortality	7	d	LC50	28	Polster & Halacka 1971
Oryzias laptipes	mortality	2	d	LC50	78	Nagase et al. 1991
Other Species and/or Parameters						
Insects						
Aedes aegypti	mortality	1	d	LC50	430	Das et al. 1984
Culex pipiens	mortality	24	h	LC50	0.290	Gras et al. 1965
Fungi						
Multispecies	mortality	72	h	MIC	500	Van der Kerk 1962

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Tributyltin acetate							
56-36-0							
Jointed worms							
Tubifex tubifex	mortality	48	h	LC50		8	Polster & Halacka 1971
Cochlea							
Biomphalaria glabrata	mortality	3	d	LC50		25	Pereira De Souza & Paulini 1970
Buccinum undatum	imposex	8	m	NOEC		0.0083	Mensink et al 1996
Buccinum undatum	imposex	8	m	LOEC		0.017	Mensink et al. 1996
Buccinum undatum	growth (length), juvenile inhibited by 25%	19	m	LOEC		0.0083	Mensink et al. 1996
Bulinus nasutus	mortality	24	h	LC50		15	Webbe et al. 1964

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Tri-n-butyltin chloride							
1461-22-9							
Bacteria							
Multispecies (6 species)	MIC	72	h	MIC	<	1000	Hallas et al. 1981
Pseudomonas aeruginosa	MIC	72	h	MIC		300000	Hallas et al. 1981
Photobacterium phoshoreum	inhibited illuminating potential	0.5	h	EC50		10	Crisinel et al. 1994
Algae							
Selenastrum capricornutum	growth	96	h	NOEC		4	Miana et al. 1993
Crustaceans							
Acartia tonsa	mortality	8	d	EC50		0.015	Kusk & Petersen 1997
Acartia tonsa	mortality	2	d	EC50		0.470	Kusk & Petersen 1997
Acartia tonsa	larval development	8	d	EC50		0.003	Kusk & Petersen 1997
Acartia tonsa	larval development	8	d	LOEC		0.001	Kusk & Petersen 1997
Acartia tonsa	mortality	6	d	LOEC		0.024	Bushong et al. 1990
Acartia tonsa	mortality	6	d	NOEC		0.010	Bushong et al. 1990
Acartia tonsa	mortality	6	d	EC10	<	0.010	Bushong et al. 1990
Artemia salina	mortality	1	d	LC50		220	Crisinel et al. 1994

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Tri-n-butyltin chloride							
1461-22-9							
Daphnia magna	immobilization	24	h	EC50		13	Vighi & Calamari 1985
Daphnia magna	mortality	48	h	LC50		5	Polster & Halacka 1971
Daphnia magna	mortality	120	h	LC50		3,4	Meador 1986
Daphnia magna	immobilization	2	d	EC50		9 8	Miana et al. 1993
Daphnia magna	immobilization	2	d	EC50		18	Crisinel et al. 1994
Eohaustorius estuarius	mortality	10	d	LC50		2	Meador 1997
Eohaustorius washingtonianus	mortality	10	d	LC50		2	Meador 1997
Eurytemora affinis	reproduction	13	d	NOEC	<	0.1	Hall 1988
Stretocephalus rubricaudatus	mortality	1	d	LC50		53	Crisinel et al. 1994
Stretocephalus texanus	mortality	1	d	LC50		15	Crisinel et al. 1994
Temora longicornis	biomass, microcosmos	14	d	EC50		0.15	Jak et al. 1998
Fish							
Lebistes reticulatus	mortality	7	d	LC50		21	Polster & Halacka 1971
Oryias lapites	mortality	2	d	LC50		36	Nagase et al. 1991
Phoxinus phoxinus	mortality, larvae	8	d	NOEC	<	0.73	Fent & Meier 1992
Phoxinus phoxinus	mortality, embryos	9	d	NOEC		0.72	Fent & Meier 1992
Platichthys stellatus	mortality	10	d	LC50		4	Meador 1997
Salmo gairdneri	mortality	10	d	LC100		5	Seinen et al. 1981
Salmo gairdneri	growth	110	d	TC		0.2	Seinen et al. 1981
Salmo gairdneri	mortality	14	d	LC100		4.9	Vries et al. 1990
Salmo gairdneri	mortality	110	d	LC25		0.2	Vries et al. 1990
Salmo gairdneri	mortality	110	d	NOEC		0.040	Vries et al. 1990
Salmo gairdneri	behaviour	110	d	NOEC	<	0.040	Vries et al. 1990

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Other Species and/or Parameters							
Shells							
Mytilus edulis	growth	33	d	NOEC		0.006	Lapota et al. 1993
Fungi							
Debaryomyces hansenii	no data	72	h	MIC		5000	Hallas et al. 1981
Rotifers							
Brachionus calyciflorus	mortality	1	d	LC50		72	Crisinel et al. 1994
Cochlea							
Nucella lima	mortality	4	m	NOEC		0.064	Stickle et al. 1990
Nucella lima	imposex	4	m	NOEC	<	0.064	Stickle et al. 1990
Worms							
Armandia brevis	mortality	10	d	LC50		4	Meador 1997
Tubifex tubifex	mortality	48	h	LC50		20	Polster & Halacka 1971
Neanthes arenaceodentata	growth	70	d	NOEC		0.05	Moore et al. 1991

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Tributyltin fluoride 1983-10-4							
Algae							
Algae	population test	4	d	EC50		1.5	Ward 1984
Skeletonema costatum	mortality	3	d	LC50		11.9	Walsh et al. 1985
Skeletonema costatum	growth	3	d	EC50	>	0.250	Walsh et al. 1985
Skeletonema costatum	mortality	3	d	EC50		9.3	Walsh et al. 1985
Crustaceans							
Gammarus oceanicus	mortality	8	w	NOEC		0.3	Laughlin 1984
Nitocra spinipes	mortality	96	h	LC50		2	Linden et al. 1979
Nitocra spinipes	mortality	4	d	LC50		0 8	Linden et al. 1979
Fish							
Alburnus alburnus	mortality	96	h	LC50		7	Linden et al. 1979
Alburnus alburnus	mortality	4	d	LC50		2.3	Linden et al. 1979
Cyprinodon variegatus	growth, embryo	28	d	NOEC		0.34	Cardwell & Sheldon 1986
Ictalurus punctatus	mortality	96	h	LC50		12	Zabel et al. 1988
Lebistes reticulatus	mortality	7	d	LC100		30	Hall et al. 1985
Salmo gairdneri	mortality	48	h	LC50		19	Floch et al. 1964
Other Species and/or Parameters							
Amphibians							
Rana temporaria	mortality	5	d	LC50		30	Laughlin & Linden 1982
Shells							
Crassostrea gigas	onogenesis	21	d	TC		0.025	Ward 1984
Crassostrea gigas	onogenesis	2	d	EC50		0.5	Ward 1984
Crassostrea gigas	mortality, embryo	21	d	NOEC		0.025	Cardwel & Sheldon 1986

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Tributyltin oxide							
56-35-9							
Bacteria							
Photobacterium phosphoreum	luminescence	30	min	EC50		1.1	Steinhäuser et al. 1985
Pseudomonas putida	growth	18	h	EC10		50	ACIMA AG 1985
Algae							
Ankistrodesmus falcatus aci	growth	8	d	EC50		5	Wong et al. 1982
Chlorella pyrenoidosa	growth	4	d	EC50		42	Mathijssen-Spiekman et al. 1989
Chlorella pyrenoidosa	cell multiplication	4	d	TC		18	Mathijssen-Spiekman et al 1989
Dunaliella tertiolecta	cell multiplication	24	d	TC		0.1	Beaumont & Newman 1986
Pavlova lutheri	cell multiplication	24	d	TC		0.1	Beaumont & Newman 1986
Scenedesmus pannonicus	growth	4	d	EC50		64	Mathijssen-Spiekman et al. 1989
Scenedesmus pannonicus	cell multiplication	4	d	TC		32	Mathijssen-Spiekman et al. 1989
Scenedesmus subspicatus	biomass	2	d	EC10		30	Kühn & Pattard 1990
Scenedesmus subspicatus	biomass	2	d	EC50		60	Kühn & Pattard 1990
Skeletonema costatum	growth	3	d	EC50		0.330	Walsh et al. 1985
Skeletonema costatum	cell multiplication	24	d	TC		0.1	Beaumont & Newman 1986
Thalassiosira guillardii	growth	3	d	EC50		0.970	Walsh et al. 1985
Blue-green algae							
Anabaena flos-aquae	photosynthesis	4	h	EC50		13	Wong et al. 1982
Aquatic plants							
Elodea sp.	mortality	10	d	LC100		500	Deschiens et al. 1968
Elodea sp.	growth	10	d	TC		30	Floch et al. 1964
Lemna media	mortality	10	d	LC100		500	Deschiens et al. 1968
Lemna media	growth	10	d	TC		30	Floch et al. 1964
Crustaceans							
Acartia tonsa	mortality	6	d	LC50		0.550	U' Ren 1983
Acartia tonsa	mortality	6	d	NOEC	<	0.3	U' Ren 1983
Cypridopsis hartwigi	mortality	48	h	LC100		2000	Deschiens et al 1968
Cypridopsis hartwigi	mortality	96	h	LC100		120	Floch et al. 1964
Daphnia longispina	mortality	24	h	LC100		120	Deschiens et al. 1968

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Daphnia longispina	mortality	72	h	LC100		60	Floch et al. 1964
Daphnia magna	immobilization	24	h	EC50		14	Vighi & Calamari 1985
Daphnia magna	immobilization	24	h	EC50		36	Steinhäuser et al. 1985
Daphnia magna	immobilization	2	d	EC50		0.750	Mathijssen-Spiekman et al. 1989
Daphnia magna	mortality	48	h	LC50		1.670	UK Department of the Environment 1986
Daphnia magna	mortality	48	h	LC50		3	Polster & Halacka 1971
Daphnia magna	mortality	20	d	LC50		1.8	Mathijssen-Spiekman et al 1989
Daphnia magna	immobilization	1	d	EC50		30	Kühn et al. 1989
Daphnia magna	reproduction	21	d	NOEC		0.160	Kühn et al. 1989
Daphnia magna	reproduction	21	d	NOEC		0.2	Analyt. Bio-Chemistry Laboratories Inc. 1990
Daphnia magna	reproduction	21	d	LOEC		0.4	Analyt. Bio-Chemistry Laboratories Inc. 1990
Daphnia magna	reproduction	20	d	EC50		2.1	Mathijssen-Spiekman et al. 1989
Hemigrapsus nudus	mortality	14	d	TC		25	Laughlin & French 1980
Homarus americanus	mortality	6	d	TC100		5	Laughlin & French 1980
Homarus americanus	mortality	24	d	TC100		20	Laughlin & French 1980
Homarus americanus	mortality	24	d	TC		1	Laughlin & French 1980
Nitocra spinipes	mortality	96	h	LC50		2	Linden et al. 1979
Palaemonetes pugio	mortality	4	d	LC50		20	Clark et al. 1987
Palaemonetes pugio	moulting	21	d	NOEC	<	0.1	Khan et al. 1993
Palaemonetes pugio	mortality, larvae	4	d	LC50		4.1	Khan et al. 1993
Penaeus duorarum	mortality	1	d	LC50		15	Heitmuller 1977
Penaeus duorarum	mortality	2	d	LC50		13	Heitmuller 1977
Penaeus duorarum	mortality	4	d	LC50		11	Heitmuller 1977
Rhithropanopeus harrisii	mortality	10	d	LC50		0.35	Laughlin et al. 1984
Uca pugilator	regeneration	7	d	TC		0.5	Weis & Kim 1988
Fish							
Alburnus alburnus	mortality	96	h	LC50		15	Linden et al. 1979
Carassius auratus	mortality	24	h	LC100		75	Deschiens et al. 1968
Cyprinodon variegatus	mortality	6	d	LC50		1.7	Cramm. 1979

Species	Effect	Time		Value	Conc. [µg/l]	Reference
Cyprinodon variegatus	reproduction	10	d	TC	1.020	Cramm 1979
Fundulus heteroclitus	mortality	4	d	LC50	18	Buccafusco 1976
Fundulus heteroclitus	behaviour	40	min	TC	1	Pinkey et al. 1985
Gasterosteus aculeatus	mortality	4	d	LC50	13	Mathijssen-Spiekman et al. 1989
Gasterosteus aculeatus	mortality	225	d	NOEC	0.1	Holm et al. 1991
Gasterosteus aculeatus	mortality	225	d	TC	0.160	Holm et al. 1991
Ictalurus punctatus	mortality	96	h	LC50	12	UK Department of the Environment 1986
Lebistes reticulatus	mortality	24	h	LC50	10	Zabel et al. 1988
Lebistes reticulatus	mortality	7	d	LC50	39	Polster & Halacka 1971
Lebistes reticulatus	mortality	30	d	LC5	6	Cardarelli 1973
Lepomis macrochirus	mortality	96	h	LC50	7.6	UK Department of the Environment 1986
Leuciscus idus	mortality	48	h	LC50	50	Plum 1981
Oncorhynchus mykiss	mortality	4	d	LC50	1.280	Martin et al. 1989
Oncorhynchus mykiss	histopathology	28	d	TE	1	Schwaiger et al. 1992
Oncorhynchus mykiss	phagocytosis	28	d	TE	2	Schwaiger et al. 1992
Oncorhynchus tshawytscha	mortality	4	d	LC50	1.5	Short & Thrower 1987
Oryzias latipes	behaviour	28	d	NOEC	3.2	Wester et al. 1990
Oryzias latipes	histopathology	28	d	NOEC	0.320	Wester et al. 1990
Oryzias latipes	mortality	4	d	LC50	16	Mathijssen-Spiekman et al. 1989
Oryzias latipes	mortality	104	d	LC50	7.5	Mathijssen-Spiekman et al. 1989
Oryzias latipes	behaviour	28	d	EC50	1.8	Mathijssen-Spiekman et al. 1989
Pimephales promelas	mortality	4	d	LC50	2.7	Geiger et al. 1990
Poecilia reticulata	histopathology	90	d	NOEC	0.010	Wester & Canton 1987
Poecilia reticulata	growth	90	d	NOEC	0.320	Wester &. Canton 1987
Poecilia reticulata	mortality	4	d	LC50	21	Mathijssen-Spiekman et al. 1989
Poecilia reticulata	behaviour	4	d	EC50	7.5	Mathijssen-Spiekman et al. 1989
Salvelinus namaycush	mortality	4	d	LC50	5.210	Martin et al. 1989
Other Species and/or Parameters						
Amphibians						
Rana temporaria	mortality	24	h	LC100	75	Deschiens et al. 1968
Rana temporaria	mortality	48	h	LC100	50	Floch et al. 1964

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Rana temporaria	mortality	4	d	LC50		1 650	Hooftman et al. 1989
Insects							
Aedes aegypti	mortality	1	d	LC50		17	Das et al.1984
Aeschna sp.	mortality	48	h	LC100		250	Deschiens et al. 1968
Chironomus riparius	mortality	4	d	LC50		3 360	Hooftman et al. 1989
Chironomus plumosus	mortality	4	d	LC50		0.05	Fargasova 1998
Culex pipiens	mortality	24	h	LC50		0 380	Gras et al. 1965
Notonectes sp.	mortality	72	h	LC100		60	Floch et al. 1964
Shells							
Anodonta cygnea	growth	8	d	TC		0.2	Machado et al. 1989
Corbicula fluminea	mortality	24	h	LC50		2100	Foster 1981
Crassostrea gigas	respiration	14	d	TC		0.020	Lawler & Aldrich 1987
Crassostrea gigas	growth	48	d	NOEC		0.010	Lawler & Aldrich 1987
Crassostrea gigas	growth, effect 58%	28	d	TC		0.005	Nell & Chvojka 1992
Crassostrea gigas	growth	28	d	NOEC	<	0.005	Nell & Chvojka 1992
Crassostrea gigas	growth, effect 38%	56	d	TC		0.15	Waldock & Thain 1983
Crassostrea virginica	mortality	90	d	TC		0.050	Pickwell & Steinert 1988
Crassostrea virginica	onogenesis	2	d	EC50		0.9	Hollister 1977
Mercenaria mercenaria	mortality	2	d	LC50		1	Laughlin et al. 1989
Mercenaria mercenaria	growth	14	d	TC		0.010	Laughlin et al. 1988
Mercenaria mercenaria	growth	14	d	NOEC	<	0.0048	Laughlin et al. 1988
Mercenaria mercenaria	growth NOEC = LOEC / 2 (geom. measured)	14	d	NOEC		0.0024	Laughlin et al. 1988
Mytilopsis sallei	mortality	4	d	LC50		53	Karande et al. 1993
Mytilus edulis	cytogenetic effect	1	d	TC		0.050	Dixon & Prosser 1986
Mytilus edulis	mortality	10	d	TC100		0.2	Beaumont & Budd 1984
Mytilus edulis	mortality	4	d	TC		0.050	Dixon & Prosser 1986
Mytilus edulis	mortality	15	d	TC		0.020	Beaumont & Budd 1984
Mytilus edulis	mortality	90	d	TC		0.050	Pickwell & Steinert 1988
Mytilus edulis	growth	7	d	NOEC		0.1	Strongren & Bongard 1987

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Mytilus edulis	growth	15	d	TC		0.020	Beaumont & Budd 1984
Perna viridis	mortality	4	d	LC50		4.8	Karande et al. 1993
Sacostrea cucullata	mortality	4	d	LC50		25	Karande et al. 1993
Sacostrea commercialis	growth, effect 79%	28	d	TC		0.005	Nell & Chvoika 1992
Scrobicularia plana	reproduction	2	d	EC50		0.25	Ruiz et al 1995
Cochlea							
Australorbis glabratus	mortality	24	h	LC50		40	Ritchie, L.S. et al. 1964
Australorbis glabratus	mortality	24	h	LC50		50	Hopf et al. 1966
Biomphalaria camerounensis	mortality	24	h	LC100		45	Deschiens et al. 1966
Biomphalaria camerounensis	mortality	4	d	LC100		15	Deschiens et al. 1966
Biomphalaria glabrata	mortality	24	h	LC50	>	50	Hopf et al. 1967
Biomphalaria glabrata	mortality	2	d	LC100		10	Ritchie et al. 1974
Biomphalaria glabrata	mortality	4	d	LC100		30	Deschiens, R. et al. 1966
Biomphalaria glabrata	mortality	6	d	LC100		15	Deschiens, R. et al. 1966
Biomphalaria glabrata	mortality	85	d	LC95		1	Ritchie et al. 1974
Biomphalaria glabrata	mortality	85	d	LC60		0.1	Ritchie et al. 1974
Biomphalaria glabrata	mortality	34	d	LC65		1	Ritchie et al. 1974
Biomphalaria glabrata	reproduction	14	d	EC50		0.1	Ritchie et al. 1974
Biomphalaria glabrata	reproduction	85	d	EC100		1	Ritchie et al. 1974
Biomphalaria glabrata	reproduction	85	d	EC80		0.1	Ritchie et al. 1974
Biomphalaria glabrata	reproduction	85	d	TC		0.001	Ritchie et al. 1974
Biomphalaria glabrata	mortality	3	d	LC50		32	Pereira De Souza & Paulini 1970
Biomphalaria glabrata	mortality	3	d	LC50		39	Pereira De Souza & Paulini 1970
Lymnaea stagnalis	mortality	4	d	LC50		42	Mathijssen-Spiekman et al. 1989
Lymnaea stagnalis	mortality	33	d	LC50		1.5	Mathijssen-Spiekman et al. 1989
Lymnaea stagnalis	reproduction	33	d	EC50		0.380	Mathijssen-Spiekman et al. 1989
Lymnaea stagnalis	reproduction	33	d	TC		0.320	Mathijssen-Spiekman et al. 1989
Physa acuta	mortality	2	d	LC50		4800	Nishiuchi & Yoshida 1972
Semisulcospira libertina	mortality	2	d	LC50		5800	Nishiuchi & Yoshida 1972

Species	Effect	Time		Value	Conc. [µg/l]	Reference
Echinoderms						
Ophioderma brevispina	regeneration	28	d	TC	0.010	Walsh et al. 1986
Ophioderma brevispina	regeneration	28	d	TC	0.010	Walsh et al. 1986
Ophioderma brevispina	regeneration	28	d	TC	0.1	Walsh et al. 1986
Ophioderma brevispina	regeneration	28	d	TC	0.1	Walsh et al. 1986
Worms						
Tubifex tubifex	mortality	48	h	LC50	6	Polster & Halacka 1971
Tubifex tubifex	mortality	96	h	LC50	0.1	Fargasova 1998

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Triphenyltin compounds

Triphenyltin hydroxide - CAS Number: 76-87-9
Triphenyltin chloride - CAS Number: 639-58-7
Triphenyltin acetate - CAS Number: 900-95-8

Quality Target

Protected Asset	Water (µg/l)
Aquatic Communities	0.0005
Drinking Water Supply	0.1

1. General

Triphenyltin compounds are used as active ingredients in antifouling paint, as fungicides in farming, as wood preservatives and to control mucous in paper manufacturing and coolant water. Their main mode of action is oxidative phosphorylation inhibition.
In Germany, triphenyltin compounds are no longer used except in pesticides.

2. Aquatic Communities

Results from long-term tests to assess the ecotoxicological effects are available for bacteria, algae, crustaceans and fish. All toxicity values were converted and refer to the triphenyltin ion. The most sensitive test results are listed in section 4. The lowest value from long-term tests was recorded for fish (Oncorhynchus mykiss) with an NOEC of 0.045 µg/l.

The quality target for aquatic communities was derived by multiplying the NOEC of the most sensitive fish species by the compensation factors F1 = 0.1 and F2 = 0.1.
(QT = 0.045 x 0.1 x 0.1 = 0.00045 µg/l, rounded 0.0005 µg/l). The compensation factor F2 was introduced to account for an additional taxonomic group (molluscs) which showed the lowest value with an LC50 of 0.00056 µg/l.

3. Drinking Water Supply

The maximum value of 0.1 µg/l determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is 0.1 µg/l.

4. Test Results

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Triphenyltin chloride							
639-58-7							
Bacteria							
Photobacterium phosphoeum	bioluminescence	30	min	EC50		14.3	Steinhäuser et al. 1985
Bacillus subtilis	growth	12	h	TC		882	Yatome et al 1993
Bacillus subtilis	growth	12	h	EC50		2602	Yatome et al 1993
Algae							
Phaeodactylum tricornutum	growth	3	d	NOEC		0.087	Liying et al 1990
Phaeodactylum tricornutum	growth	3	d	EC50		0.84	Liying et al 1990
Skeletonema costatum	growth	3	d	EC50		0.84	Walsh et al 1985
Porphyra yezoensis	growth	4	d	TC	<	0.9	Maruyama et al 1991
Thalassiosira pseudonana	growth	3	d	EC50		1.22	Walsh et al 1985
Porphyra yezoensis	growth	2	d	TC	<	1.45	Maruyama et al 1991
Ankistrodesmus falcatus	growth	8	d	EC50		1.8	Wong et al 1982
Plankton	^{14}C fixation	28	h	EC50		1.8	Wong et al 1982
Ankistrodesmus falcatus	^{14}C fixation	28	h	EC50		9.1	Wong et al 1982
Anabaena flos-aquae	^{14}C fixation	28	h	EC50		18.2	Wong et al 1982
Scenedesmus quadricauda	^{14}C fixation	28	h	EC50		36.3	Wong et al 1982
Crustaceans							
Daphnia magna	immobilization	1	d	EC50		32	Steinhäuser et al 1985
Fish							
Oncorhynchus mykiss	mortality	110	d	NOEC	≥	0.045	Vries et al 1991
Oncorhynchus mykiss	mortality	110	d	LOEC		0.2	Vries et al 1991
Cochlea							
Indoplanorbis exustus	mortality	1	d	LC50		0.00056	Goel & Prasad 1978
Indoplanorbis exustus	mortality	1	d	LC90		0.0024	Goel & Prasad 1978

Species	Effect	Time		Value		Conc. [µg/l]	Reference
Triphenyltin acetate							
900-95-8							
Algae							
Skeletonema costatum	growth	3	d	EC50		0.73	Walsh et al 1985
Thalassiosira pseudonana	growth	3	d	EC50		0.93	Walsh et al 1985
Insects							
Chironomus riparius	mortality	2	d	LC50		50	Cotta-Ramusino & Doci 1987
Chironomus riparius	mortality	1	d	LC50		70	Cotta-Ramusino & Doci 1987
Cochlea							
Bulinus nasutus	mortality	3	d	LC50		12	Webe & Sturrock 1964
Australorbis glabratus	mortality	2	d	LC50		70	Frick & de Jeminez 1964
Australorbis glabratus	mortality	3	d	LC50		400	Seiffer & Schoof 1967
Australorbis glabratus	mortality	3	d	LC95		1400	Seiffer & Schoof 1967
Triphenyltin hydroxide							
76-87-9							
Algae							
Skeletonema costatum	growth	3	d	EC50		0.56	Walsh et al 1985
Thalassiosira pseudonana	growth	3	d	EC50		1.02	Walsh et al 1985
Crustaceans							
Daphnia magna	no data	21	d	LOEC	<	1.4	U.S. EPA 1995
Fish							
Pimephales promelas	no data	183	d	LOEC	>	0.01	U.S. EPA 1995
Pimephales promelas	growth	30	d	NOEC		0.14	Jarvinen et al 1988
Pimephales promelas	growth	30	d	LOEC		0.22	Jarvinen et al 1988

Species	Effect	Time	Value	Conc. [µg/l]	Reference
Pimephales promelas	mortality	30 d	LC50	1.4	Jarvinen et al 1988
Pimephales promelas	growth	4 d	EC50	3.5	Jarvinen et al 1988
Pimephales promelas	mortality	4 d	LC50	6.8	Jarvinen et al 1988
Shells					
Crassostrea virginica	no data	4 d	EC50	0.31	U.S. EPA 1995

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