



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 Länder 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 if legally binding 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.

Literatur

Gesetz zur Ordnung des Wasserhaushalts (Wasserhaushaltsgesetz - WHG) v. 23.09.1986 (BGBl I S 1529, ber. 1654, geändert durch G v. 27.06 1994, BGBl I S 1440)

Vorschlag für eine Richtlinie des Rates zur Schaffung eines Ordnungsrahmens für Maßnahmen der Gemeinschaft im Bereich der Wasserpolitik (Wasserrahmenrichtlinie), Stand 02.03.1999

LAWA (Länderarbeitsgemeinschaft Wasser) (1997).

Zielvorgaben zum Schutz oberirdischer Binnengewässer, Band I, Teil I: Konzeption zur Ableitung von Zielvorgaben zum Schutz oberirdischer Binnengewässer vor gefährlichen Stoffe, Teil II: Erprobung der Zielvorgaben von 28 gefährlichen Wasserinhaltsstoffen in Fließgewässern, Berlin

LAWA (Länderarbeitsgemeinschaft Wasser) (1998):

Zielvorgaben zum Schutz oberirdischer Binnengewässer, Band II: Ableitung und Erprobung von Zielvorgaben zum Schutz oberirdischer Binnengewässer für die Schwermetalle Blei, Cadmium, Chrom, Kupfer, Nickel, Quecksilber und Zink, Berlin

Canadian Council of Ministers of the Environment: (1999)

Canadian Environmental Quality Guidelines, Canadian Council of Ministers of the Environment, Winnipeg

IKSR - Internationale Kommission zum Schutze des Rheins (1995):

Aktionsprogramm Rhein: Stoffdatenblätter für die Zielvorgaben, Koblenz

4. Internationale Nordseeschutzkonferenz (1995):

Ministererklärung, NOTEX-Verlag, Kopenhagen

Irmer, U., Wolter, R., Kussatz, C. (1993):

Problemereich Pflanzenschutzmittel aus wasserwirtschaftlicher Sicht.

Agrarspektrum 21: 22-33

Irmer, U., Markard, C., Blondzik, K., Gottschalk, C., Kussatz, C., Rechenberg, B., Schudoma, D.

(1994): Ableitung und Erprobung von Zielvorgaben für gefährliche Stoffe in Oberflächengewässern.

UWSF - Z. Umweltchem. Ökotox. 6: 19-27

Irmer, U., Markard, C., Blondzik, K., Gottschalk, C., Kussatz, C., Rechenberg, B., Schudoma, D.

(1995): Quality targets for concentrations of hazardous substances in surface waters in Germany.

Ecotox. Environ. Safety 32: 233-243

Kussatz, C. (1994):

Aquatic field studies in ecotoxicological assessment of hazardous substances.

Environ. Toxicol. Wat. Qual.: An International Journal, 9: 281-284

Rechenberg, J. (1997):

Die geplante EG-Wasserrahmenrichtlinie - Chancen und Risiken für den Gewässerschutz.

Umwelt Technologie Aktuell 3: 201-205

Gesetz zum Schutz der Kulturpflanzen (Pflanzenschutzgesetz - PflSchG) (vom 15.09.1986) (BGBl. I S. 971) in Kraft am 01.01.1987, zuletzt geändert am 30.04.1998, BGBl. I S. 823

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 interval.

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

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
Terbutylazine	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 $F1 = 0.1$.

($QT = 5\mu\text{g/l} \times 0.1 = 0.5\mu\text{g/l}$). 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

5. Bibliography

Bathe, R., Ullmann, L., Sachsse, K., 1972
 Toxizitätsbestimmung von Pflanzenschutzmitteln an Fischen.
 SchrReihe Ver. Wass.- Boden- Lufthyg., H.37

BBA, 1998
 Liste der Wirkstoffe in zugelassenen Pflanzenschutzmitteln
 www.bba.de, Phytomed-Datenbank
 Biologische Bundesanstalt, Braunschweig

Hollister, T.A., Walsh, G.E., 1973

Differential responses of marine Phytoplankton to Herbicides: Oxygen evolution.

Bulletin of Environmental Contamination & Toxicology, Vol.9, No.5, 291 - 295

Tscheu-Schlüter, M., 1976

Zur akuten Toxizität von Herbiziden gegenüber ausgewählten Wasserorganismen

Teil 2: Triazinherbizide und Amitrol.

Acta hydrochim. Hydrobiol. 4 (2): 153 - 170

U.S EPA, Office of Pesticide Programs, 1995

Environment Effects Database (EEDB)

Environment Fate and Effects Division, U.S. EPA, Washington, D.C.

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 $F1 = 0.1$.

($QT = 0.1 \text{ µg/l} \times 0.1 = 0.01 \text{ µg/l}$). 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

5. Bibliography

- Adelmann, I.R., Smith, L.L.Jr., Siesennop, G.D., 1976
Chronic toxicity of guthion to the fathead minnow (*Pimephales promelas* Rafinesque).
Bulletin of Environmental Contamination & Toxicology 15: 726-733
- BBA, 1993
Wirkstoffdatenblatt: Azinphos-methyl, Entwurf
BBA/0063/93/04,
Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig
- BBA, 1998
Liste der Wirkstoffe in zugelassenen Pflanzenschutzmitteln
www.bba.de, Phytomed-Datenbank,
- Cripe, G.M., Goodman, L.R., Hansen, D.J., 1984
Effect of chronic exposure to EPN and to Guthion on the critical swimming speed and brain acetylcholinesterase activity of *Cyprinodon variegatus*.
Aquat. Toxicol. 5 (3): 255 - 266
- Dive, D., Leclerc, H., Personne, G., 1980
Pesticide toxicity on the ciliate protozoan *Colpidium campylum*: possible consequences of the effect of pesticides in the aquatic environment.
Ecotoxicology and Environmental Safety 4: 129-133
- Dortland, R.J., 1980
Toxicological evaluation of parathion and azinphosmethyl in freshwater model ecosystems.
Agric. Res. Rep. (Versl. landbouwk. Onderz.) 898, 112 p.
- Frear, D.E.H., Boyd, J.E., 1967
Use of *Daphnia magna* for the microbioassay of pesticides. I. Development of standardized techniques for rearing daphnia and preparing of dosage-m...
J. Econ. Entomol. 60 (5): 1228-1236
- Holocomb, G.W., Phipps, G.L., Sulaiman, A.H., Hoffmann, A.D., 1987
Simultaneous multiple species testing: Acute toxicity of 13 chemicals to 12 diverse freshwater amphibian, fish, and invertebrates families.
Arch. Environ. Contam. Toxicol. 16: 697-710
- Kadlec, M.C., Benson, W.H., 1995
Relationship of aquatic natural organic material characteristics to the toxicity of selected insecticides.
Ecotoxicology and Environmental Safety 31: 84-97
- PSM-Datenbank (PSM database),
Umweltbundesamt (Federal Environmental Agency), Berlin
- Sanders, H.O., 1969
Toxicity of pesticides to the crustacean *Gammarus lacustris*.
Tech. Paper No. 25, Bur. Sport Fish. Wildl., Fish Wildl. Serv., U.S.D.I.: 18 p.

Sanders, H.O., 1972

Toxicity of some insecticides to four species of malacostracan crustaceans.

Tech. Paper No. 66, Bur. Sport Fish. Wildl., Fish Wildl. Serv., U.S.D.I.: 19 p.

Tanner, D.K., Knuth, M.L., 1995

Effects of azinphos-methyl on the reproductive success of the bluegill sunfish, *Lepomis macrochirus*, in littoral enclosures.

Ecotoxicology and Environmental Safety 32: 184-193

Technical Guidance Documents (TGD) in Support of the Commission Directive 93/67/EEC on Risk Assessment for New Notified Substances and the Commission Regulation (EC) 1488/94 on Risk Assessment for Existing Substances, 19th April 1996

Weiss, C.M., Gakstatter, J.H., 1964

Detection of pesticides in water by biochemical assay.

J. Water Pollut. Control. Fed. 36 (2): 240-253

Bentazon3-(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 bibrarianus	no data	4 d	NOEC <	980	BBA 1993
Ankistrodesmus bibrarianus	no data	4 d	NOEC	1950	PSM database
Chlorella fusca	growth	1 d	EC50	42500	Faust et al. 1993
Ankistrodesmus bibrarianus	no data	4 d	EC50	47300	PSM database 1994
Ankistrodesmus bibrarianus	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
<u>Bentazon sodium salt</u>					
Algae					
Pseudokirchneriella sub	biomass	3 d	NOEC	732	PSM database 1994
<u>Lysimeter percolate</u>					
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

5. Bibliography

Bazin, C., Chambon, P., 1980

Etudes des effets des substances suivantes sur l'environnement aquatique: 132 Bentazone.

Institut Pasteur de Lyon, France

BBA, 1993

Wirkstoffdatenblatt Bentazon (Entwurf)

BBA / 0335 / 93 / 08

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

BBA, 1998

Liste der Wirkstoffe in zugelassenen Pflanzenschutzmitteln

www.bba.de, Phytomed-Datenbank

Faust, M., Altenburger, R., Boedeker, W., Grimme, 1993

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),

Umweltbundesamt (Federal Environmental Agency), Berlin

Bromacil5-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 $F1 = 0.1$.
($QT = 6 \mu\text{g/l} \times 0.1 = 0.6 \mu\text{g/l}$).

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

5. Bibliography

BBA, 1998

Liste der Wirkstoffe in zugelassenen Pflanzenschutzmitteln.

www.bba.de, Phytomed-Datenbank

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

Call, D.J., Brooke, L.T., Kent, R.J., Knuth, M.I., Poirier, S.H., Huot, J.M., 1987

Bromacil and Diuron herbicides: toxicity, uptake, and elimination in freshwater fish.

Arch. Environ. Contam. Toxicol. 16, 607-613

PSM-Datenbank (PSM database),

Umweltbundesamt (Federal Environmental Agency), Berlin

Schäfer, H., Hettler, H., Fritsche, U., Pitzen, G., Röderer, G., Wenzel, A., 1994

Biotests using unicellular algae and ciliates for predicting longterm effects of toxicants.

Ecotoxicology and Environmental Safety 27, 64-81

U.S. EPA, Office of Pesticide Programs, 1995

Environmental Effects Database (EEDB).

Environmental Fate and Effects Division, U.S. EPA, Washington, D.C.

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 $F1 = 0.1$.
($QT = 118 \text{ µg/l} \times 0.1 = 11.8 \text{ µg/l}$, 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

5. Bibliography

BBA, 1998

Liste der Wirkstoffe in zugelassenen Pflanzenschutzmitteln

www.bba.de, Phytomed-Datenbank

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

PSM-Datenbank (PSM database),

Umweltbundesamt (Federal Environmental Agency), Berlin

U.S. EPA, Office of Pesticide Programs, 1995

Environmental Effects Database (EEDB).

Environmental Fate and Effects Division, U.S. EPA, Washington, D.C.

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

5. Bibliography

Anton, F.A., Ariz, M., Alia, M., 1993

Ecotoxic effects of four herbicides (glyphosate, Alachlor, chlortoluron and isoproturon) on the algae *Chlorella pyrenoidosa* chick.

The Science of the Total Environment, Supplement 1993 Elsevier Science Publishers B. V., Amsterdam, 845-851

Bathe, R., Ullmann, L., Sachsse, K., 1972

Toxizitätsbestimmung von Pflanzenschutzmitteln an Fischen.

SchrReihe Ver. Wass.- Boden- Lufthyg., H. 37

BBA, 1993

Wirkstoffdatenblatt Chlortoluron (Entwurf)

BBA / 0279 / 93 / 03

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

BBA, 1998

Liste der Wirkstoffe in zugelassenen Pflanzenschutzmitteln

www.bba.de, Phytomed-Datenbank

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

Faust, M., Altenburger, R., Boedeker, W., Grimme, 1993

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),

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 canadensis*, *Myriophyllum spicatum* and *Vallisneria spiralis*, 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 phenoxyacetic 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 perpusilla* by the compensation factor $F1 = 0.1$. ($QT = 20 \mu\text{g/l} \times 0.1 = 2 \mu\text{g/l}$). The quality target for the overall concentration of all 2,4-D variants and their conversion products (with regard to 2,4-D) is $2 \mu\text{g/l}$.

3. Drinking Water Supply

The maximum value of $0.1 \mu\text{g/l}$ determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is $0.1 \mu\text{g/l}$.

4. Test Results

Species	Effect	Time	Value	Conc. $\mu\text{g/l}$	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

5. Bibliography:

BBA, 1993

Wirkstoffdatenblatt 2.4-D, Entwurf

BBA/0027/93/05

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

BBA, 1998

Liste der Wirkstoffe in zugelassenen Pflanzenschutzmitteln

www.bba.de, Phytomed-Datenbank

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

Bird, K.T., 1993

Comparisons of herbicide toxicity using in vitro cultures of *Myriophyllum spicatum*.

J. Aquat. Plant Manage. 31: 43-45

Christopher, S. V., Bird, K. T., 1992

The effects of herbicides on development of *Myriophyllum spicatum* L. cultured in vitro.

J. Environ. Qual., Vol. 21, 203-207

Fargasova, A., 1994

Comparative study of plant growth hormone herbicide toxicity in various biological subjects.

Ecotoxicology and Environmental Safety 29, 359-364

Faust, M., Altenburger, R., Boedeker, W., Grimme, L. H., 1993

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

Finlayson, B.J., Verrue, K.M., 1985

Toxicities of butoxyethanol ester and propylene glycol butyl ether ester formulations of 2,4-Dichlorophenoxy acetic acid (2,4-D) to juvenile salmonids.

Arch. Environ. Contam. Toxicol. 142:153-160

Göncz, A. M., Sencic, L., 1994

Metolachlor and 2,4-dichlorophenoxyacetic acid sensitivity of *Salvinia natans*.

Bull. Environ. Contam. Toxicol. 53, 852-855

Kaiser, K.L.E., Palabrica, V.S., 1991

Photobacterium phosphoreum. Toxicity data index

Water Poll. Res. J. Canada 26: 361-431 (BfG-Datenbank)

Kwasniewska, K., Liu, D., Strachan, W.M.J., 1980

The relative biological toxicity effectiveness of chemicals toward microorganisms.

Trace Subst. in Environ. Health 14: 470-477

O' Brien, M. C., Prendeville, G. N., 1979

Effect of herbicides on cell membrane permeability in *Lemna minor*.

Weed Research, Vol. 19, 331-334

Pelekis, M. L., Mangat, B. S., Krishnan, K., 1987
Influence of 2,4 - Dichlorophenoxyacetic acid on the Growth and Stored Polyglucan Content of
Three Species of Heterotrophic Algae.
Pesticide Biochemistry and Physiology 28, 349-353

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

Quinn, S.A. et al., 1977
Aquatic herbicide chrononicity.
Journal Aquatic Plant Mangement 15: 74-76

Schott, C.D., Worthly, E.G., 1974
The toxicity of TNT and related wastes to an aquatic flowering plant, 'Lemma perusila' Torr..
Edgewood Arsenal Tech. Rep. EB-TR-74016, U.S. NTIS AD-778158

Somasundaram, L. et al., 1990
Application of the Microtox system to assess the toxicity of pesticides and their hydrolysis
metabolites.
Bull. Environ. Contam. Toxicol., 44:254-259

Sutton, D.L., Bingham, S.W., 1970
Uptake and Translocation of 2,4-D-1-14C in Parrotfeather.
Weed Science 18, 2: 193-196

Tag El-Din, A., Abbas, M.M., Aly, H.A., Tantawy, G., Askar, A., 1981
Acute toxicities to *Mugil cephalus* caused by some herbicides and new pythroids.
Med Fac Landbouw Rijkuniv Gent 46/1: 387-391

Westerdahl, H., Hall, J.F., 1983
Threshold 2,4-D concentrations for control of Eurasian Watermilfoil and Sago Pondweed.
J. Aquat. Plant Manage., 21: 22-25

Woodward, D.F., Mayer, F.L.Jr., 1978
Toxicity of Three Herbicides Butyl, Isooctyl, and Propylene Glycol Butyl Ether Esters of 2,4-D
to Cutthroat Trout and Lake Trout.
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 phenoxy-carboxylic 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 ≤ 40 µg/l.

In the case of plants, a combinatory effect can be expected whenever several active ingredients of phenoxy-carboxylic 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					
<i>Pseudomonas putida</i>	no data	96 h	NOEC	100000	PSM database
Algae					
<i>Chlorella pyrenoidosa</i>	no data	96 h	EC0	35100	PSM database
Crustaceans					
<i>Daphnia magna</i>	no data	48 h	EC50	5400	U.S. EPA 1995
<i>Daphnia magna</i>	reproduction	21 d	NOEC <	10000	PSM database
Fish					
<i>Oncorhynchus mykiss</i>	mortality	96 h	LC50	500	U.S. EPA 1995
<i>Poecilia reticulata</i>	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					
Myriophyllum 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 gorbusha	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

5. Bibliography

BBA, 1998

Liste der Wirkstoffe in zugelassenen Pflanzenschutzmitteln.

www.bba.de, Phytomed-Datenbank

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

Huber, W., Zieris, F.J., Daxl, R., Fiel, S., 1995

Untersuchungen zur Verwendung von künstlichen Teichen als standardisierte Testsysteme zur Abschätzung des Umweltrisikos von Pflanzenschutzmitteln mit Hilfe der Wirkung und des Verbleibs von zwei Herbiziden.

Umweltbundesamt, Forschungsbericht Nr. 96-006, Berlin

PSM-Datenbank (PSM database),

Umweltbundesamt (Federal Environmental Agency), Berlin

U.S. EPA, Office of Pesticide Programs, 1995

Environmental Effects Database (EEDB).

Environmental Fate and Effects Division, U.S. EPA, Washington, D.C.

Wan, M.T., Watts, R.G., Moul, D.J. (1990):

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 $F1 = 0.1$.

($QT = 0.006 \text{ µg/l} \times 0.1 = 0.0006 \text{ µg/l}$). 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

5. Bibliography

Amann, W., 1989

Bewertung wassergefährdender Stoffe

BMU, Ministry of the Environment, Nature Conservation and Nuclear Safety, Research Report
No.: 10205308

BBA, 1998

Liste der Wirkstoffe in zugelassenen Pflanzenschutzmitteln

www.bba.de, Phytomed-Datenbank

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

Bruns, E., Knacker, Th., 1998

Untersuchung der Wirkung gefährlicher Stoffe auf aquatische Organismen zur Ableitung von Zielvorgaben.

BMU, Ministry of the Environment, Nature Conservation and Nuclear Safety, Research Report
No.: 10601067

Johnson, W.W., Finley, M.T., 1980

Handbook of acute toxicity of chemicals to fish and aquatic invertebrates.

United States Department of the Interior Fish and Wildlife Service / Resource Publication 137
Washington, D.C.

Mc Henery, J.G., Francis, C., Davies, I.M., 1996

Threshold Toxicity and Repeated Exposure Studies of Dichlorvos to the Larvae of the Common
Lobster (*Homarus gammarus* L.).

Aquatic Toxicology 34, 237-251

Pal, A.K., 1983

Acute Toxicity of DDVP to Fish, Plankton and Worm.

Environment & Ecology 1, 25

Pal, A.K., Konar, S.K., 1985

Chronic Effects of the Organophosphorus Insecticide DDVP on Feeding, Survival, Growth and Reproduction of Fish.

Environment & Ecology 3 (3), 398-402

PSM-Datenbank (PSM database),

Umweltbundesamt (Federal Environmental Agency), Berlin

Raine, R.C.T., Cooney, J.J., Coughlan, M.F., Parching, J.W., 1990

Toxicity of Nuvan and Dichlorvos Towards Marine Phytoplankton.

Botanica Marina 33, 533-537

U.S. EPA, Office of Pesticide Programs, 1995

Environmental Effects Database (EEDB).

Environmental Fate and Effects Division, U.S. EPA, Washington, D.C.

Varanka, I., 1987

Effect of Mosquito Killer Insecticides on Freshwater Mussels.

Com. Biochem. Physiol. Vol. 86C, No. 1, pp. 157-162

Verma, S.R., Tonk, I.P., Dalela, R.C., 1981

Determination of the Maximum Acceptable Toxicant Concentration (MATC) and the safe Concentration for Certain Aquatic Pollutants.

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 = 23 µg/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
<i>Channa punctatus</i>	biochemical	35 d		410	Ghosh 1987
<i>Oncorhynchus mykiss</i>	growth	21 d	LOEC	2000	PSM database 1990
	growth	21 d	NOEC	400	PSM database 1990
<i>Oryzias latipes</i> (eggs)	mortality	40 d		320	Slooff & Canton 1983
<i>Cyprinus carpio</i>	mortality	1-1.25 d		1000	Kulshrestha & Arora 1986
<i>Lepomis macrochirus</i>	mortality	4 d	LC 50	6000	Johnson & Finley 1980
<i>Tilapia mossambica</i>	reproduction	7 d		1200	Manna & Sadhukhan 1986
Other Species and/or Parameters					
Amphibians					
<i>Rana hexadactyla</i>	mortality	12 h	LC 50	8.12	Khargarot et al. 1985
<i>Rana hexadactyla</i>	mortality	4 d	LC 50	7.82	Khargarot et al. 1985
<i>Xenopus laevis</i>	mortality	100 d		1000	Slooff & Canton 1983
Insects					
Chironomidae	mortality	1 d	LC 50	40.20	Joshi et al. 1975
<i>Pteronarcys californica</i>	mortality	4 d	LC 50	43	Sanders & Cope 1968
<i>Culex pipiens</i>		25 d		320	Slooff & Canton 1983
Cochlea					
<i>Heliosoma trivolvis</i>	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				
<i>Lymnaea acuminata</i>		2 d	LC 50	24.5	Chaudhari et al. 1988

5. Bibliography

Aboul-Ela, I., Khalil, M.T., 1987 A

The chronic toxicity of three pollutants upon the freshwater snail *Heliosoma trivolvis*.

Proc. Zool. Soc. A.R.Egypt, 13: 17 - 29

Aboul-Ela, I., Khalil, M.T., 1987 B

The acute toxicity of three pesticides on organisms of different trophic levels as parameters of pollution in lake Wadi El Rayan, El Fayoum, Egypt.

Proc. Zool. Soc. A.R.Egypt, 13: 31 - 36

BBA, 1998

Liste der Wirkstoffe in zugelassenen Pflanzenschutzmitteln

www.bba.de, Phytomed-Datenbank

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

Beusen, J.M., Neven, B., 1989

Toxicity of dimethoate to *Daphnia magna* and freshwater fish.

Bull. Environ. Contam. Toxicol. 42 (1) 126-133

Canton, J.H., Wegman, R.C.C., Van Oers, A., Tammer, A.H.M., Mathijssen-Spiekman, E.A.M., Van den Broek, H.H., 1980

Environmental toxicological research with dimethoate and omethoate.

National Institute of Public and Environmental Hygiene, Report No. 121/80: 6 p.)DUT)

Chaudhari, T.R., Jadhav, M.L., Lomte, V.S., 1988

Acute toxicity of organophosphates to fresh water snails from Panzara river at Dhule, MS.

Environ. Ecol. 6 (1) 244-246

Deneer, J.W., Seinen, W., Hermens, J.L.M., 1988

Growth of *Daphnia magna* exposed to mixtures of chemicals with diverse modes of action.

Ecotoxicol. Environ. Saf. 15 (1) 72-77

Ghosh, T.K., 1987

Effect of dimethoate on tissue glycogen content of some freshwater fishes.

Aquat. Sci. Fish. Abstr., Part 1, 17 (4) 179; Environ Ecol 4 (4) 554-557 (1986) (ABS)

Gill, T.S., Pant, J.C., Pant, J., 1988

Gill, liver, and kidney lesions associated with experimental exposures to carbaryl and dimethoate in the fish (*Puntius conchoni* Ham.).

Bull. Environ. Contam. Toxicol. 41 (1) 71-78

Ibrahim, E.A., 1983

Effects of some common pesticides on growth and metabolism of the unicellular algae *Skeletonema costatum*, *Amphiprora paludosa* and *Phaeodactylum tri...*

Aquat. Toxicol. 3 (1) 1-14

Johnson W.W., Finley, M.T., 1980

Handbook of acute toxicity of chemicals to fish and aquatic invertebrates.

Resource Publication 137, Fish and Wildlife Service, U.S.D.I., Washington, D.C.

Joshi, H.C., Kapoor, D., Panwar, R.S., Gupta, R.A., 1975
Toxicity of some insecticides to chironomid Larvae.
Indian J. Environ. Health 17 (3) 238-241

Khargarot, B.S., Sehgal, A., Bhasin, M.K., 1985
Man and biosphere-studies on the Sikkim Himalayas. Part 6: Toxicity of selected pesticides to frog tadpole *Rana hexadactyla* (Lesson).
Acta Hydrochim. Hydrobiol. 13 (3) 391-394

Kulshrestha, S.K., Arora, N., 1986
Effect of carbofuran, dimethoate and DDT on early development of *Cyprinus carpio*, Linn.
Part 1: Egg mortality and hatching.
J. Environ. Biol. 7 (2) 113-119

Manna, G.K., Sadhukhan, A., 1986
Induction of letal mutations in the fish *Oreochromis mossambicus* by an insecticide, Rogor 30E and the method of its detection.
Natl. Acad. Sci. Lett. (India) 9 (8) 249-251

Pant, J.C., Singh, T., 1983
Inducement of Metabolic Dysfunction by carbamate and organophosphorus compounds in a fish, *Puntius conchoniis*.
Pestic. Biochem. Physiol. 20 (3) 294-298

Portmann, J.E., Wilson, K.W., 1971
The toxicity of 140 substances to the brown shrimp and other marine animals.
Shellfish Information Leaflet No. 22 (2nd Ed.) Ministry of Agric. Fish Food, Burnham-on-Crouch, Essex, 12 p

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

Sanders, H.O., Cope, O.B., 1968
The relative Toxicities of several pesticides to Naiads of three species of stoneflies.
Limnol. Oceanogr. 13 (1) 112-117 (authors communication used)

Slooff, W., Canton, J.H., 1983
Comparison of the susceptibility of 11 freshwater species to 8 chemical compounds.
II. (semi)chronic toxicity tests.
Aquat. Toxicol. 4 (3) 277-282

Wong, P.K., Chang, L., 1988
The effects of 2,4-D Herbicide and organophosphorus insecticides on growth, photosynthesis, and chlorophyll a synthesis of *Chlamydomonas reinhardtii* (mt +).
Environ. Poll. 55, 179-189

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 $F1 = 0.1$.
($QT = 0.46 \mu\text{g/l} \times 0.1 = 0.046 \mu\text{g/l}$, rounded $QT = 0.05 \mu\text{g/l}$).

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

5. Bibliography

BBA, 1998

Liste der Wirkstoffe in zugelassenen Pflanzenschutzmitteln

www.bba.de, Phytomed-Datenbank

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

Bringmann, G., Kühn, R., 1974

Quantitative Bestimmung der biologischen Schadwirkung herbizider Phenylharnstoff-Derivate gegen Algen (Modellorganismus: *Scenedesmus quadricauda*)

gwf-wasser/abwasser 115: 364-366

Bringmann, G., Kühn, R., 1975

Wirkung herbizider Phenylharnstoff-Derivate gegen Blaualgen (Modellorganismen :

Microcystis aeruginosa bzw. *Nostec spec.*

gwf-wasser/abwasser 116: 366-369

Cain, J.R., Cain, R.K., 1983

The effects of selected herbicides on zygospore germination and growth of *Chlamydomonas moewusii chlorophyceae*, volvocales.

J. Phycol. 19, 301-305.

Call, D.J., Brooke, L.T., Kent, R.J., Knuth, M.I., Poirier, S.H., Huot, J.M., 1987

Bromacil and diuron herbicides: toxicity, uptake, and elimination in freshwater fish.

Arch. Environ. Contam. Toxicol. 16, 607-613.

Datenbank zur Toxikologie der Herbizide, 1981

Weinheim

Debourg, C. et al. 1993

KEMI Report No. 2, The Swedish National Chemicals Inspectorate

Hughes, J.S., 1973

Acute Toxicity of Thirty Chemicals to Striped Bass *Morone saxatilis*.

Louisiana Dep. Wildl. Fish. 318-343-2417:15 p. Used 963 As Reference AQUIRE: 2012

IRPTC - International Register of Toxic Chemicals 1989

UNEP

Johnson, W.W., Finley, M.T., 1980

Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates.

Resour. Publ. 137, Fish Wildl. Serv., U.S.D.I., Washington, D.C.:98 p. AQUIRE: 666

Korostylev, M.V., 1977

Effect of Diluron, Dilor and Methylnitrophos on Chironomids.

Izv. Gos. Nauchno - Issled. Inst. Ozern. Rechn. Rybn. Khoz. 121:161-164 RUS ENG ABS
AQUIRE: 7545

Liu, L.C., A.Cendeno-Maldonado, 1974

Effects of Fluometuron, Prometryne, Ametryne, and Diuron on Growth of Two Lemna Species

J. Agric. Univ. P.R. 63(4):483-488, (AQUIRE: 8628)

- Macek, K.J., Hutchinson, D., Cope, O.B., 1969
The Effects of Temperature on the Susceptibility of Bluegills and Rainbow Trout to Selected Pesticides
Bull. Environ. Contam. Toxicol. 4(3): 174-183
- McFeters, G. A., Bond, P. J., Olson S. B., Tchan, Y. T., 1983
A comparison of microbial bioassay for the detection of aquatic toxicants.
Water Res. 17: 1752-1762.
- Molander, S., Blanck, H., 1992
Detection of pollution-induced community tolerance PICT in marine periphyton communities established under diuron exposure.
Aquatic Toxicology, 22 1992 129-144
- PSM-Datenbank (PSM database),
Umweltbundesamt (Federal Environmental Agency), Berlin
- Reddy, D.C. et al., 1992
Changes in erythropoietin activity of *Sarotherodon mossambicus* exposed to sublethal concentrations of the herbicide diuron.
Bull. Environ. Contam. Toxicol. 49:730-737.
- Sanders, H.O., 1969
Toxicity of Pesticides to the Crustacean *Gammarus lacustris*.
Tech. Paper No. 25, Bur. Sports Fish. Wildl., Fish Wildl. Serv., U.S.D.I.: 18 P. Used with Reference 732 AQUIRE: 885
- Schäfer, H., Hettler, H., Fritsche, U., Pitzen, G., Röderer, G., Wenzel, A., 1994
Biotests using unicellular algae and ciliates for predicting long-term effects of toxicants.
Ecotoxicology And Environmental Safety 27, 64-81.
- Shcherban, E.P., 1972
The Effect of Low Concentrations of Pesticides on the Development of Some Cladocera and the Abundance of Their Progeny.
Hydrobiol J. 66:85-89; Gidrobiol Zh. Kiev 66:101-105 RUS AQUIRE: 9260
- Süssmuth, R., Lenz, P., Müller, D., 1992
Effect of Test Conditions and Interfering Factors on Sensitivity of Bacterial Tests Based on Inhibition of Growth and Motility.
Environmental Toxicology and Water Quality: An International Journal Vol. 7, 257-274 1992

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 $F1 = 0.1$.

($QT = 0.05 \times 0.1 = 0.005 \text{ µg/l}$). 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
Pseudomonas 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
<i>Daphnia magna</i>	reproduction, immobilization	21 d	NOEC	63	PSM database
<i>Daphnia magna</i>	no data	21 d	LC 50	300	PSM database
<i>Diaptomus</i> sp.	mortality (mixed population)	2 d	LC 50	0.6	Naqvi & Hawkins 1989
<i>Eucyclops</i> sp.	mortality (mixed population)	2 d	LC 50	0.1	Naqvi & Hawkins 1989
<i>Gammarus roeselii</i>	immobilization	3 d	EC 0	0.5	Matthias 1990
<i>Gammarus roeselii</i>	immobilization	3 d	EC 50	9.8	Matthias 1990
<i>Palaemonetes pugio</i>	mortality	4 d	NOEC	0.032	Moore 1989
<i>Penaeus duorarum</i>	mortality	4 d	LC 50	0.04	Schimmel et al. 1977
Fish					
<i>Carassius auratus</i>	mortality	2 d	LC 50	0.1	Hashimoto & Nishiuchi 1981
<i>Catostomus commersoni</i>	mortality	4 d	LC 50	3.0	Schoettger 1970
<i>Catostomus commersoni</i>	mortality	4 d	LC 50	3.5	Schoettger 1970
<i>Catostomus commersoni</i>	mortality	5 d	LC 50	2.5	Schoettger 1970
<i>Channa punctatus</i>	mortality	4 d	LC 50	0.16	PSM database
<i>Cyprinus carpio</i>	mortality	4 d	LC 50	0.1	Sunderam et al. 1992
<i>Heteropneustes fossilis</i>	mortality	4 d	LC 50	2.0	Singh & Srivastava 1982
<i>Heteropneustes fossilis</i>	mortality	3 d	LC 50	2.5	Singh & Srivastava 1982
<i>Heteropneustes fossilis</i>	mortality	2 d	LC 50	2.9	Singh & Srivastava 1982
<i>Heteropneustes fossilis</i>	mortality	1 d	LC 50	3.3	Singh & Srivastava 1982
<i>Labeo rohita</i>	mortality	4 d	LC 50	1.1	Rao et al. 1980
<i>Lepomis macrochirus</i> (pond test, USA)	no data	210 d	NOEC	1.3	PSM database
<i>Lepomis macrochirus</i>	mortality	1 d	LC 50	2.7	PSM database
<i>Morone saxatilis</i>	mortality	4 d	LC 50	0.048	Korn & Russel 1974
<i>Mystus vittatus</i>	mortality	4 d	LC 50	0.79	Verma et al. 1981
<i>Mystus vittatus</i>	mortality	3 d	LC 50	0.9	Verma et al. 1981
<i>Mystus vittatus</i>	mortality	2 d	LC 50	1.4	Verma et al. 1981
<i>Mystus vittatus</i>	mortality	1 d	LC 50	1.9	Verma et al. 1981
<i>Oncorhynchus mykiss</i>	no data	21 d	NOEC	0.05	PSM database
<i>Oncorhynchus mykiss</i>	mortality	21 d	LC 50	0.283	PSM database
<i>Oncorhynchus mykiss</i>	mortality	4 d	LC 50	0.7	Sunderam et al. 1992
<i>Oncorhynchus mykiss</i>	mortality (flow- through system, 12 single tests)	4 d	LC 50	0.17- 0.75	Lemke 1980
<i>Oncorhynchus mykiss</i>	mortality (static system, 12 single tests)	4 d	LC 50	0.49- 2.43	Lemke 1980
<i>Oncorhynchus mykiss</i>	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

5. Bibliography:

BBA, 1998

Liste der Wirkstoffe in zugelassenen Pflanzenschutzmitteln

www.bba.de, Phytomed-Datenbank

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

BBA, 1993

Wirkstoffdatenblatt: Endosulfan, Entwurf

BBA/0050/93/01

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

De La Cruz, A.A., Yarbrough, J.D., 1982

The role of aquatic weeds in maintaining surface water quality.

Proj. No. A-134-MS, U.S.D.I., Water Resour. Res. Inst., Mississippi State Univ., Mississippi State, MS: 53 p.

Frear, D. E. H., Boyd, J. E., 1967

Use of *Daphnia magna* for the microbioassay of pesticides. I. Development of standardized techniques for rearing daphnia and preparing of dosage-m...

J. Econ. Entomol. 60 (5): 1228-1236

Hashimoto, Y., Nishiuchi, Y., 1981

Establishment of bioassay methods for the evaluation of acute toxicity of pesticides to aquatic organisms.

J. Pest. Sci. 6 (2): 257-264

Johal, M.S., Dua, A., 1995

Elemental lepidological and toxicological studies in *Channa punctatus* (Bloch) upon exposure to an organochlorine pesticide, endosulfan.

Bull. Environ. Contam. Toxicol. 55: 916-921

Knauf, W., Schulze, E.-F., 1973

New findings on the toxicity of endosulfan and its metabolites to aquatic organisms.

Mededeling, Facultät f. Landbouwwetenschappen, Rijksuniversität Gent 38: 717-732

Knie, J., Hälke, A., Juhnke, I., Schiller, W., 1983

Ergebnisse der Untersuchungen von chemischen Stoffen mit vier Biotests.

Deutsche Gewässerkundliche Mitteilungen (DGM) 27: 77-79

Korn, S., Russel, E., 1974

Acute toxicity of twenty insecticides to Striped Bass, *Morone saxatilis*
Calif. Fish and Game 60 (3): 128 - 131

Lemke, A. E., 1980

Interlaboratory comparison acute testing set.

EPA-600/3-81-005, Environ. Res. Lab., U.S. EPA, Duluth, MN: 29 p., U.S. NTIS PB 81-160772

Macek, K.J., Lindberg, M.A., Sauter, S., Buxton, K.S., Costa, P.A., 1976

Toxicity of four pesticides to water fleas and fathead minnows. Acute and chronic toxicity of acrolein, heptachlor, endosulfan and trifluralin to the water flea (*Daphnia magna*) and the fathead minnow (*Pimephales promelas*).

EPA-600/3-76-099, Environ. Res. Lab., Duluth, MN: 68 p., NTIS PB-262 912

Magadza, C.H.D., 1983

Toxicity of endosulfan to some aquatic organisms of Southern Africa.

Zimbabwe J. agric. Res. 21 (2): 159-165

Matthias, U., 1990

Ökotoxikologische Bewertung des SANDOZ-Schadenfalles anhand von Laboruntersuchungen; Sonderprojekt: „Ökologische Schäden im Rhein durch den SANDOZ-Schadenfall“.

Landesanstalt für Umweltschutz Baden-Württemberg, Institut für Wasser- und Abfallwirtschaft

Matthiessen, P., Logan, J.W.M., 1984

Low concentration effects of endosulfan insecticide on reproductive behavior in the tropical cichlid fish *Sarotherodon mossambicus*.

Bull. Environ. Contam. Toxicol. 33: 575-583

Moore, D.W., 1989

An integrated laboratory and field study of nonpoint source agricultural insecticide runoff and its effect on the Grass Shrimp, *Palaemonetes pugio*.

Diss. Abstr. Int. B Sci. Eng. 50 (2): 482 - 483; Ph.D Thesis, Univ. of South Carolina: 323 p

Naqvi, S.M., Hawkins, R.H., 1989

Responses and LC₅₀ values for selected microcrustaceans exposed to spartan®, malathion, sonar®, weedtrine-D® and oust® pesticides.

Bull. Environ. Contam. Toxicol. 43: 386-393

Nowak, B., 1992

Histological changes in gills induced by residues of endosulfan.

Aquatic Toxicology 23: 65-84

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

Rao, D.M.R., Devi, A.P., Murty, A.S., 1980
Relative Toxicity of Endosulfan, its Isomers, and Formulated Products to the Freshwater Fish
Labeo rohita
Journal of. Toxic. And Environ. Health, 6: 825-834

Schimmel, S.C., Patrick, A.M. Jr., Wilson, A.J. Jr., 1977
Acute toxicity and bioconcentration of endosulfan by estuarine animals.
In: F.L. Mayer and J.L. Hamelink (Eds.), Aquatic toxicology and hazard evaluation, 1st
Symposium, ASTM STP 634, Philadelphia, PA: 241 - 252

Schimmel, S.C., 1981 A
Results: Interlaboratory Comparison - Acute toxicity tests using estuarine animals.
Final Draft, EPA 600/4-81-003, US EPA, Gulf Breeze, FL:13 p.

Schoettger, R. A., 1970
Toxicology of Thiodan in several fish and aquatic invertebrates.
Invest. Fish Control No. 35, U.S.D.I., 31 p.

Singh, N.N., Srivastava, A.K., 1982
Toxicity of a mixture of aldrin and formothion and other organophosphorus, organochlorine
and carbamate pesticides to the indian catfish, *Heteropneustes fossilis*
Comp. Physiol. Ecol. 7 (2) B: 115-118, 9 (1) B: 63-66 (1984)

Sunderam, R.I.M., Cheng D.M.H., Thompson, G.B., 1992
Toxicity of endosulfan to native and introduced fish in Australia.
Environ. Toxicol. Chem. 11: 1469-1476

Toledo, M.C.F., Jonsson, C.M., 1992
Bioaccumulation and elimination of endosulfan in zebra fish (*Brachydanio rerio*).
Pestic. Sci. 36 (3): 207-211

UBA-Texte 65/95, 1995
Fachgespräch Umweltchemikalien mit endokriner Wirkung

Verma, S.R., Rani, S., Bansal, S.K., Dalela, R.C., 1981
Evaluation of the comparative toxicity of thiotox, dichlorvos and carbofuran to two freshwater
teleosts *Ophiosephalus punctatus* and *Mystus vittatus*.
Acta Hydrochim. Hydrobiol. 9 (2): 199-129

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 $F1 = 0.1$. ($QT = 0.04 \times 0.1 = 0.004$). 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

5. Bibliography

Batelle Europe,
Final Report, 1991 (not published)

BBA, 1998
Liste der Wirkstoffe in zugelassenen Pflanzenschutzmitteln
www.bba.de, Phytomed-Datenbank
Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

Matthias, U., 1990
Ökotoxikologische Bewertung des SANDOZ-Schadenfalles anhand von
Laboruntersuchungen; Sonderprojekt: „Ökologische Schäden im Rhein durch den SANDOZ-
Schadensfall“.
Landesanstalt für Umweltschutz Baden-Württemberg, Institut für Wasser- und
Abfallwirtschaft, Karlsruhe

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 $F1 = 0.1$.

($QT = 0.087 \text{ µg/l} \times 0.1 = 0.0087 \text{ µg/l}$, 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 paucideus	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
Galaxias 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
Bufo americanus 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	$\geq 0 < 15$	Davies et al. 1994
Oncorhynchus mykiss	AChE activity, respiration	20 d	NOEC	$\geq 0 < 15$	Davies et al. 1994
Pimephales promelas (embryos 6-12 h old)	biomass	31 d	NOEC MAT C	$> 130 < 300$	Kleiner et al. 1984
Salmo salar	behaviour	7 d	EC	0.004	Morgan & Kiceniuk 90
Crustaceans					
Callinectes sapidus	regeneration	3 d	EC	0.01	Johnston & Corbett 85
Paratya australiensis	mortality	10 d	NOEC	$\geq 1.3 < 5.4$	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 coeruleus	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

5. Bibliography

BBA, 1998

Liste der Wirkstoffe in zugelassenen Pflanzenschutzmitteln

www.bba.de, Phytomed-Datenbank

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

De Bruijn, J., Hermens, J., 1991

Uptake and elimination kinetics of organophosphorous pesticides in the guppy (*Poecilia reticulata*): Correlations with the octanol/water partition ...

Environ. Toxicol. Chem. 10 (6): 791-804

Berrill, M., Bertram, S., McGillivray, L., Kolohon, M., Pauli, B., 1994

Effects of low concentrations of forest-use pesticides on frog embryos and tadpoles.

Environ. Toxicol. Chem. 13: 657-664

Berrill, M., Bertram, S., Pauli, L.B., Coulson, D., Kolohon, M., Ostrander, D., 1995

Comparative sensitivity of amphibian tadpoles to single and pulsed exposure of the forest-use insecticide fenitrothion.

Environ. Toxicol. Chem. 14: 1011-1018

Canton, J.H., 1990

Inhaalmanoeuvre oude bestrijdingsmiddelen: en integratie

RIVM-Reportno.: 678801001

Davies, P.E., Cook L.S.J., Goenarso, D., 1994

Sublethal responses to pesticides of several species of Australian freshwater fish and crustaceans and rainbow trout.

Environ. Toxicol. Chem. 13: 1341-1354

Ferrando, M.D., Andreu, E., Almar M., Cebrian, C., 1987

Acute exposure of organochlorine pesticides to the European eel, *Anguilla anguilla*: the dependency on exposure time and temperature.

Bull. Environ. Contam. Toxicol. 39: 365-369

Hashimoto, Y., Nishiuchi, Y., 1981

Establishment of bioassay methods for the evaluation of acute toxicity of pesticides to aquatic organisms.

J. Pest. Sci. 6 (2): 257-264

International Programme on Chemical Safety (IPCS), 1992

Environmental Health Criteria 133 Fenitrothion.

WHO, Geneva, 184 p.

Johnson, W.W., Finley, M.T., 1980

Handbook of acute toxicity of chemicals to fish and aquatic invertebrates.

US-Dept. Interior, Fish and Wildlife Services 137

Johnston, J.J., Corbett, M.D., 1985

The effect of temperature, salinity and a simulated tidal cycle on the toxicity of fenitrothion to *Callinectes sapidus*.

Comp. Biochem. Physiol. 80 C (1): 145 - 149

Kanazawa, J., 1981

Measurement of the bioconcentration factors of pesticides by freshwater fish and their correlation with physicochemical properties or acute toxicities.

Pestic. Sci. 12(4): 417-424

Kent, R.A., Currie, D., 1995

Predicting algal sensitivity to a pesticide stress.

Environ. Toxicol. Chem. 14: 983-991

Kikuchi, R., Takimoto, Y., Yamada H., Miyamoto, J., 1984

Effect of fenitrothion on growth of a green alga, *Chlorella vulgaris*.

Journal of Pesticide Science 9: 325-329

Kleiner, Ch.F., Anderson, R.L., Tanner, D.K., 1984

Toxicity of fenitrothion to fathead minnows (*Pimephales promelas*) and alternative exposure duration studies with fenitrothion and endosulfan.

Arch. Environ. Contam. Toxicol. 13: 573-578

Knaur, K., Toor, H.S., 1977

Toxicity of pesticides to embryonic stages of *Cyprinus carpio communis* Linn.

Indian J. of Experimental Biology 15: 193-196

Kwasniewska et al., 1980 (zitiert nach IPCS, 92)

The relative biological toxicity effectiveness of chemical toward microorganisms.

Trace Subst. Environ. Health, 14: 470-477

Miyamoto, J., Takikomoto, Y., Mihara, K., 1979

Metabolism of organophosphorus insecticides in aquatic organisms, with special emphasis on fenitrothion.

ACS (Am. Chem. Soc.) Symp. Ser. 99: 3-20

Morgan, M.J., Kiceniuk, J.W., 1990

Effect of fenitrothion on the foraging behavior of juvenile Atlantic salmon.

Environ. Toxicol. Chem. 9 (4): 489-495

Muller, R., 1970

Laboratory experiments on the control of cyclops transmitting guinea worm.

Bull. Wld. Hlth. Org. 42. 563-567

Nair, G.A., Nair, B.N., 1982

Effects of certain organophosphate biocides on the juvenile of the isopod, *Alitropus typus* M. Edwards (Crustacea: Flabellifera: Aegidae).

J. Anim. Morphol. Physiol. 29: 265-271

Patwardhan, S.A., Gaikwad, S.A., 1991

Size dependent toxicity of sumithion EC 50 on *Gambusia affinis* (Baird and Girard)
Pollution Research 10 (1): 43-45

Pawar, K.R., Katdare, M., 1983

Acute toxicity of Sumithion, BHC and Furadan to some selected freshwater organism.
Biovigyanam (Journal of life science (Poona)) 9: 67-72

Sarojini, R., Nagabhushanam, R., Mary, Sr. A., 1986

Effect on fenitrothion on reproduction of freshwater prawn *Macrobrachium lamerii*.
Ecotoxicol. Environ. Saf. 11: 243-250

Scherer, E., 1975

Avoidance of fenitrothion to goldfish (*Carassius auratus*).
Bull. Environ. Contam. Toxicol. 13: 492-496

Svobodova, Z., 1975

Changes in the red blood picture of the carb intoxicated with organo-phosphat pesticides.
Acta Vet. Brno. 44 (1-2): 49 - 52

Takimoto, Y., Ohshima, M., Miyamoto, J., 1984

Fate of fenitrothion in several developmental stages of the killifish (*Oryzia latipes*).
Arch. Environ. Contam. Toxicol. 13 (5): 579-587

Takimoto, Y., Ohshima, M., Miyamoto, J., 1987

Comparative metabolism of fenitrothion in aquatic organisms. I. Metabolism in the
eurohyaline fish, *Oryzias latipes* and *Mugil cephalus*.
Ecotoxicol. Environ. Saf. 13 (1): 104-117

Takimoto, Y., Ohshima, M., Miyamoto, J., 1987

Comparative metabolism of fenitrothion in aquatic organisms. III. Metabolism in the
crustaceans, *Daphnia pulex* and *Palaemon paucidens*.
Ecotoxicol. Environ. Saf. 13: 126-134

Tsuda, T., Aoki, S., Kojima, M., Harada, H., 1989

Bioconcentration and excretion of diazinon, IBP, malathion and fenitrothion by willow shiner.
Toxicol. Environ. Chem. 24: 185-190

Tsuda, T., Aoki, S., Kojima, M., Harada, H., 1990

Bioconcentration and excretion of diazinon, IBP, malathion and fenitrothion by carp.
Comp. Biochem. Physiol. 96 C (1): 23-26

US-EPA, 1995

Reregistration eligibility decision (RED): Fenitrothion

PB 95-525318, NTIS

Literature MRID 40891101:

Information missing

Literature MRID 40891201:

Cohle, P., 1988

Early life stage toxicity of fenitrothion technical to rainbow trout (*salmo gairdneri*) in a flow-through-system: Final report No. 36647.

Unpublished study prepared by Analytical Bio-Chemistry Laboratories, Inc. 1009 p.

Yasuno, M., Hatakeyama, S., Miyashita, M., 1980

Effects on reproduction in the guppy (*poecilia reticulata*) under chronic exposure to temephos and fenitrothion.

Bull. Environm. Contam. Toxicol. 25: 29-33

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 $F1 = 0.1$. ($QT = 0.042 \mu\text{g/l} \times 0.1 = 0.0042 \mu\text{g/l}$, rounded $0.004 \mu\text{g/l}$). The quality target for fenthion is $0.004 \mu\text{g/l}$.

3. Drinking Water Supply

The maximum value of $0.1 \mu\text{g/l}$ determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is $0.1 \mu\text{g/l}$.

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
Simocephalus serrulatus	immobilization	2 d	EC 50	0.62	Sanders & Cope 1966
Fish					
Aplocheilichthys 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	Gauvin 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

5. Bibliography

BBA, 1998

Liste der Wirkstoffe in zugelassenen Pflanzenschutzmitteln

www.bba.de, Phytomed-Datenbank

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

BBA, 1993

Wirkstoffdatenblatt: Fenthion, Entwurf

BBA/0057/93/06

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

BBA, 1995

Wirkstoffdatenblatt: Fenthion

BBA/0057/95

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

Bluzat, R., Seuge, J., 1979

Effets de trois insecticides (lindane, fenthion et carbaryl): Toxicité aiguë sur quatre espèces d'invertébrés limniques; toxicité chronique chez le mollusque pulmoné *lymnea*.

Environ. Poll. 18: 51-70

Gaufin, A.R., Jensen, L.D., Nebeker, A.V., Nelson, T., Teel, R.W., 1965

The toxicity of ten organic insecticides to various aquatic invertebrates.

Water & Sewage Works 12: 276-279

Hall, R.J., Kolbe, E., 1980

Bioconcentration of organophosphorus pesticides to hazardous levels by amphibians.

J. Toxicol. Environ. Health 6 (4): 853-860

Hanazato, T., Kasai, F., 1995

Effects of the organophosphorus insecticide fenthion on phyto- and zooplankton communities in experimental ponds.

Environ. Poll. 88: 293-298

Hatakeyama, S., Sugaya, Y., 1989

A freshwater shrimp (*Paratya compressa improvisa*) as a sensitive test organism to pesticides.

Environ. Poll. 59: 325-336

Jakob, S.S., Nair, N.B., Balasubramanian, N.K., 1982

Toxicity of certain mosquito larvicides to the larvivorous fishes *Aplocheilichthys lineatus* (Cuv. & Val.) and *Macropodus cupanus* (Cuv. & Val.).

Environ. Poll. (Series A) 28: 7-13

Johnson, W.W., Finley, M.T., 1980

Handbook of acute toxicity of chemicals to fish and aquatic invertebrates.

Resour. Publ. 137, Fish. Wildl. Serv., U.S.D.I., Wash. D.C., 98 p.

Mane, U.H., Akarte, S.R., 1988

Toxicity of lebaycid to three freshwater lameliibranch molluscs in different seasons.

Pesticides 22 (3): 51-56

Mane, U.H., Akarte, S.R., Kulkarni, D.A., 1986

Acute toxicity of fenthion to freshwater lamellibranch mollusc, *Indonaia caeruleus* (Prashad 1918), from Godavari river at Paithan - a biochemical approach.

Bull. Environ. Contam. Toxicol. 37: 622-628

Mayer, F.L., Ellersieck, M.R., 1986

Manual of acute toxicity: Interpretation and data base for 410 chemicals and 66 species of freshwater animals.

Resource Publication 106, Fish and Wildlife Service, U.S.D.I., Wash. D. C., 508 p., NTIS PB 86-239878

Paflitschek, R., 1979

Untersuchungen über die toxische Wirkung von Bayluscid und Lebaycid auf Ei-, Jugend- und Adultstadien der Buntbarsche *Tilapia leucosticta* (Trewavas, 1933) und *Herotilapia multispinosa* (Günther, 1989).

Z. Angew. Zoologie 66 (2): 143-172

PSM-Datenbank (PSM database),

Umweltbundesamt (Federal Environmental Agency), Berlin

Roux, D., Jooste, S., Truter, E., Kempster, P., 1995

An aquatic toxicological evaluation of fenthion in the context of finch control in South Africa

Ecotoxicology and Environmental Safety 31: 164 - 172

Sanders, H.O., 1972

Toxicity of some insecticides to four species of malacostracan crustaceans.

Tech. Paper No. 66, Bur. Sport Fish. Wildl., Fish Wildl. Serv., U.S.D.I.: 19 p.

Sanders, H.O., Cope, O.B., 1966

Toxicity of several pesticides to two species of cladocerans.

Transactions of the American Fisheries Society 95 (2): 165-169

Shim, J.C., Self, L.S., 1973

Toxicity of agricultural chemicals to larvivorous fish in Korean rice fields.

Tropical Medicine 15 (3): 123-130

US EPA, 1995

Office of pesticide programs, Environmental Effects Database (EEDB)

Environmental Fate and Effects Division, US EPA Washington, D.C.

Weiss, C.M., Gakstatter, J.H., 1964

Detection of pesticides in water by biochemical assay.

Journal Water Poll. Control. Fed. 36 (2): 240-253

Hexazinone3-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	7 d	EC50	126	Abou-Waly et al. 1991
	¹⁴ C fixation	1 d	EC50	14-219	
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-Datenbank
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

5. Bibliography

Abou-Waly, H., Abou-Setta, M.M., Nigg, H.N., Mallory, L.L., 1991
Growth Response of Freshwater Algae, *Anabaena flos-aquae* and *Selenastrum capricornutum*
to Atrazine and Hexazinone Herbicides
Bull. Environ. Contam. Toxicol. 46, 223-229

BBA, 1998

Liste der Wirkstoffe in zugelassenen Pflanzenschutzmitteln
www.bba.de, Phytomed-Datenbank
Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

EPA, Office of Pesticide Programs, 1995

Environmental Effects Database (EEDB).

Environmental Fate and Effects Division, U.S. EPA, Washington, D.C.

Kreutzweiser, D.P., Holmes, S.B., Behmer, D.J., 1991

Effects of the Herbicides Hexazinone and Triclopyr Ester on Aquatic Insects.
Ecotoxicology and Environmental Safety 23, 364-374

Peterson, H.G., Boutin, C., Martin, P.A., Freemark, K.E., Ruecker, N.J., Moody, M.J., 1994
Aquatic phyto-toxicity of 23 pesticides applied at Expected Environmental Concentrations
Aquatic Toxicology 28, 275-292

PSM-Datenbank (PSM database),

Umweltbundesamt (Federal Environmental Agency), Berlin

Thompson, D.G., Holmes, S.B., Wainio-Keizer, K., MacDonald, L., Solomon, K.R., 1993
Impact of Hexazinone and Metsulfuron Methyl on the Zooplankton Community of a Boreal
Forest Lake
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 $F1 = 0.1$.

($QT = 3.2 \text{ µg/l} \times 0.1 = 0.32 \text{ µg/l}$, 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					
<i>Pseudomonas putida</i>	cell multiplication	3 d	NOEC	35000	Bruns & Knacker 1998
Algae					
<i>Chlorella pyrenoidosa</i>	growth	4 d	NOEC < (50% a.i.)	2	Anton et al 1993
<i>Scenedesmus subspicatus</i>	no data	4 d	NOEC	3.2	BBA 1993
<i>Scenedesmus subspicatus</i>	multiplication inhibition	3 d	NOEC	3.2	PSM database 1986
<i>Scenedesmus subspicatus</i>	biomass	3 d	EC10	5	PSM database 1992
<i>Scenedesmus subspicatus</i>	growth	3 d	NOEC	8	PSM database 1992
<i>Scenedesmus subspicatus</i>	cell multiplication	3 d	EC10	17	PSM database 1992
<i>Chlorella pyrenoidosa</i>	growth	4 d	EC50	20	Anton et al. 1993
<i>Chlorella pyrenoidosa</i>	growth	4 d	EC50	25	Anton et al. 1993
<i>Scenedesmus subspicatus</i>	no data	4 d	EC50	30	BBA 1993
<i>Scenedesmus subspicatus</i>	multiplication inhibition	3 d	EC50	30	PSM database 1986
<i>Scenedesmus subspicatus</i>	biomass	3 d	EC50	30	PSM database 1992
<i>Scenedesmus subspicatus</i>	cell multiplication	3 d	EC50	95	PSM database 1992
Crustaceans					
<i>Daphnia magna</i>	reproduction	21 d	NOEC	64	BBA 1993
<i>Daphnia magna</i>	reproduction	21 d	NOEC	93	PSM database 1990
<i>Daphnia magna</i>	no data	2 d	EC0	120	PSM database 1989
<i>Daphnia magna</i>	reproduction	21 d	LOEC	320	BBA 1993
<i>Daphnia magna</i>	immobilization	21 d	EC0	340	PSM database 1990
<i>Daphnia magna</i>	immobilization	21 d	EC50	340	PSM database 1990
<i>Daphnia magna</i>	reproduction	21 d	NOEC	410	PSM database 1992
<i>Daphnia magna</i>	no data	2 d	EC50	490	PSM database 1989
<i>Daphnia magna</i>	no data	2 d	EC50	710	PSM database 1989
<i>Daphnia magna</i>	immobilization	21 d	EC50	1240	PSM database 1990
<i>Daphnia magna</i>	immobilization	21 d	EC100	1240	PSM database 1990
<i>Daphnia magna</i>	no data	2 d	EC100	3290	PSM database 1989
<i>Daphnia magna</i>	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

5. Bibliography

Anton, F.A., Ariz, M., Alia, M., 1993

Ecotoxic effects of four herbicides (glyphosate, Alachlor, chlortoluron and isoproturon) on the algae *Chlorella pyrenoidosa* chick.

The Science of the Total Environment, Supplement 1993 Elsevier Science Publishers B. V., Amsterdam, 845-851

BBA, 1998

Liste der Wirkstoffe in zugelassenen Pflanzenschutzmitteln

www.bba.de, Phytomed-Datenbank

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

BBA, 1993

Wirkstoffdatenblatt Isoproturon,

BBA / 0411 / 93 / 04

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

Bruns, E., Knacker, Th., 1998

Untersuchung der Wirkung gefährlicher Stoffe auf aquatische Organismen zur Ableitung von Zielvorgaben

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

PSM-Datenbank (PSM database),

Umweltbundesamt (Federal Environmental Agency), Berlin

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 $F1 = 0.1$.
 $(QT = 2.7 \text{ µg/l} \times 0.1 = 0.27 \text{ µg/l, rounded } 0.3 \text{ µg/l})$. 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					
<i>Pseudomonas putida</i>	cell multiplication	16 h	LOEC >	5000	Bringmann & Kühn 1977
Algae					
<i>Microcystis aeruginosa</i>	cell multiplication	8 d	EC 3	300	Bringmann 1978
<i>Scenedesmus acutus</i>	cell multiplication	5 d	EC 20	1000	Krishnakumari 1977
<i>Scenedesmus quadricauda</i>	cell multiplication	8 d	EC 3	1900	Bringmann 1978
<i>Scenedesmus subspicatus</i>	cell multiplication	4 d	EC 10	500	Geyer et al. 1985
<i>Scenedesmus subspicatus</i>	cell multiplication	4 d	EC 50	2500	Geyer et al. 1985
<i>Scenedesmus subspicatus</i>	cell multiplication	3 d	NOEC	1400	Schäfer et al. 1994
<i>Scenedesmus subspicatus</i>	cell multiplication	3 d	EC 50	3200	Schäfer et al. 1994
Crustaceans					
<i>Asellus brevicaudus</i>	mortality	4 d	LC 50	10	Sanders 1972
<i>Cypridopsis vidua</i>	mortality	4 d	LC 50	3.2	Johnson & Finley 1980
<i>Daphnia magna</i>	reproduction	64 d	NOEC	> 11 < 19	Macek et al. 1976
<i>Daphnia magna</i>	growth (length)	16 d	NOEC	150	Deneer et al. 1988
<i>Daphnia magna</i>	growth (length)	16 d	EC 10	330	Deneer et al. 1988
<i>Daphnia magna</i>	reproduction	16 d	EC 50	340	Hermens et al. 1984
<i>Daphnia magna</i>	reproduction	21 d	NOEC	54	PSM database
<i>Daphnia magna</i>	no data	14 d	NOEC	100	PSM database
<i>Daphnia magna</i>	immobilization	1 d	EC 0 <	3	Knier et al. 1983
<i>Daphnia magna</i>	immobilization	2 d	EC 50	485	PSM database
<i>Daphnia magna</i>	immobilization	1 d	EC 50	1250	Frear & Boyd 1967
<i>Daphnia pulex</i>	immobilization	2 d	EC 50	460	Mayer & Ellersieck 1986
<i>Eurypanopeus depressus</i> (1-4 days old larvae)	mortality	21 d	LC 50	0.01	Shirley & McKinney 1987
<i>Eurypanopeus depressus</i> (1-4 days old larvae)	mortality	4 d	LC 50	0.66	Shirley & McKinney 1987
<i>Eurypanopeus depressus</i> (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
<i>Oncorhynchus mykiss</i>	larval weight, ELS	85 d	NOEC	2.9	PSM database
<i>Oncorhynchus mykiss</i>	larval weight, ELS	85 d	LOEC	6	PSM database
<i>Oncorhynchus mykiss</i>	no data	14 d	NOEC	8	PSM database
<i>Oncorhynchus mykiss</i>	mortality	1 d	LC 50	30	PSM database
<i>Oryzias latipes</i>		72 d	LC 50	1.2	Shim & Self 1973
<i>Salmo gairdneri</i>	mortality	4 d	LC 50	18	Mayer & Ellersieck 1986
<i>Salmo gairdneri</i>	mortality	2 d	LC 50	18	Tscheu-Schlüter & Skibba 1986
<i>Salmo gairdneri</i>	mortality	4 d	LC 50	22	Cope 1965
<i>Salmo irideus</i>	mortality	25 d	TC	1000	Boulekbache & Spiess 1974
<i>Salmo trutta</i>	mortality	4 d	LC 50	1.7	Johnson & Finley 1980
<i>Salmo trutta</i>	mortality	4 d	LC 50	2	Macek & McAllister 1970
<i>Salvelinus namaycush</i>	mortality	4 d	LC 50	24	Mayer & Ellersieck 1986
<i>Salvelinus fontinalis</i>	growth	261 d	NOEC	> 8.8 < 16.6	Macek et al. 1976
<i>Tilapia zillii</i>	mortality	4 d	LC 50	6.4	El-Sebae et al. 1986
Other Species and/or Parameters					
Fish					
<i>Channa punctatus</i>	ATPase activity	4 d	TC	30	Gopal et al. 1993
Insects					
<i>Chironimus riparius</i>	emergence time	28 d	LOEC	0.8	PSM database Maund et al. 1992
<i>Chironimus riparius</i>	mortality	10 d	LC 50	13	Taylor et al. 1991
<i>Chironimus riparius</i>	mortality	5 d	LC 50	27	Taylor et al. 1991
<i>Chironimus riparius</i>	mortality	4 d	LC 50	34	Taylor et al. 1991
<i>Limnephilus lunatus</i>	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	Metcalfe 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

5. Bibliography

BBA, 1998

Liste der Wirkstoffe in zugelassenen Pflanzenschutzmitteln

www.bba.de, Phytomed-Datenbank

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

BBA, 1993

Wirkstoffdatenblatt Lindan, Entwurf

BBA/0070/93/06

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

Boulekbache, H., Spiess, C., 1974

Effects of lindane on trout fry (*Salmo irideus* Gibb.) changes in glycolytic enzymes.

Bull. Soc. Zool. Fr. 99 (1): 79-85

Bringmann, G., Kühn, R., 1977

Grenzwerte der Schadwirkung wassergefährdender Stoffe gegen Bakterien (*Pseudomonas putida*) und Grünalgen (*Scenedesmus quadricauda*) im Zellvermehrungshemmtest.

Z. f. Wasser- und Abwasser-Forschung 10. Jhg. Nr. 3/4/77: 87-98

Bringmann, G., Kühn, R., 1978

Grenzwerte der Schadwirkung wassergefährdender Stoffe gegen Blaualgen (*Microcystis aeruginosa*) und Grünalgen (*Scenedesmus quadricauda*) im Zellvermehrungshemmtest.

Vom Wasser Vol. 50: 45-60

Cope, O.B., 1965

Sport fishery investigation.

In: U. S. Fish Wildl. Serv. Circ. 226:51-63

- Deneer, J.W., Seinen W., Hermens, J.L.M., 1988
Growth of *Daphnia magna* exposed to mixtures of chemicals with diverse modes of action.
Ecotoxicol. Environ. Saf. 14 (1): 72-77
- El-Sebae, A.H., El-Amayem, M.A., Sharaf, I., Massod, M., 1986
Factors affecting acute and chronic toxicity of chlorinated pesticides and their biomagnification in Alexandria region.
FAO Fish. Rep. 334: 73-79
- Ensenbach, U., Nagel, R., 1991
Toxicokinetics of xenobiotics in zebrafish - comparison between tap and river water.
Comp. Biochem. Physiol. 100 C (1/2): 49-53
- Ferrando, M.D., Andreu-Moliner, E., Almar, M.M., Cebrian, C., Nunez, A., 1987
Acute toxicity of organochlorinated pesticides to the European eel, *Anguilla anguilla*: The dependency of exposure time and temperature.
Bull. Environ. Contam. Toxicol. 39 (3): 365-369
- Frear, D.E.H., Boyd, J.E., 1967
Use of *Daphnia magna* for the microbioassay of pesticides. I. Development of standardized techniques for rearing daphnia and preparing of dosage-m...
J. Econ. Entomol. 60 (5): 1228-1236
- Geyer, H., Scheunert, I., Korte, F., 1985
The Effect of organic environmental chemicals on the growth of the alga *Scenedesmus subspicatus*: a contribution to environmental biology.
Chemosphere, 14: 1355-1369
- Görge, G., Nagel, R., 1990a
Toxicity of lindane, atrazine, and deltamethrin to early life stages of zebrafish (*Brachydanio rerio*).
Ecotoxicol. Environ. Saf. 20 (3): 246-255
- Görge, G., Nagel, R., 1990b
Kinetics and metabolism of ¹⁴C-lindane and ¹⁴C-atrazine in early life stages of zebrafish (*Brachydanio rerio*).
Chemosphere 21 (9): 1125-1137
- Gopal, K.M.D. Ram, D. Agarwal, 1993
Some physiological consequences to fresh water fish, *Channa punctatus*, after exposure to lindane.
Bull. Environ. Contam. Toxicol. 50: 187-191
- Hermens, J., Canton, H., Steyger, N., Wegman, R., 1984
Joint effects of a mixture of 14 chemicals on mortality and inhibition of reproduction of *Daphnia magna*.
Aquat. Toxicol. 5 (4): 315-322

- Johnson, W.W., Finley, M.T., 1980
Handbook of acute toxicity of chemicals to fish and aquatic invertebrates.
Resour. Publ. 137, Fish. Wildl. Serv., U.S.D.I., Wash. D.C., 98 p.
- Khillare, Y.K., Wagh, S.B., 1988
Toxicity of an organochlorine insecticide „lindane“ to fresh water fish *Barbus stigma*.
J. Adv. Zool. 9 (2): 83-86
- Knie, J., Hälke, A., Juhnke, I., Schiller, W., 1983
Ergebnisse der Untersuchungen von chemischen Stoffen mit vier Biotests.
Deutsche Gewässerkundliche Mitteilungen (DGM) 27: 77-79
- Krishnakumari, M.K., 1977
Sensitivity of the alga *Scenedesmus acutus* to some pesticides.
Life Sci. 20: 1525-
- Kudesia, V.P., Bali, N.P., 1984
Study of pesticides in Kalinadi River and evaluation of toxicity of some pesticides on fish *Clarias batrachus*.
Acta Ciencia Indica 10(4): 245-254
- Macek, K.J., McAllister, W.A., 1970
Insecticide susceptibility of some common fish family representatives.
Trans. Am. Fish. Soc. 99 (1): 20-27
- Macek, J.K., Buxton, K.S., Derr, S.K., Dean, J.W., Sauter, S., 1976
Chronic toxicity of lindane to selected aquatic invertebrates and fishes.
Ecol. Re. Ser., EPA-600/3-76-046, Environ. Res. Lab. U.S.-EPA, Duluth, MN. 49 p., NTIS PB-256 334
- Matsumura, F., 1977
Absorption, accumulation and elimination of pesticides by aquatic organisms.
Environ. Sci. Res. 10: 77 - 105
- Mayer, F.L., Ellersieck, M.R., 1986
Manual of acute toxicity: Interpretation and data base for 410 chemicals and 66 species of freshwater animals.
Resource Publication 106, Fish and Wildlife Service, U.S.D.I., Wash. D. C., 508 p., NTIS PB 86-239878
- Metcalf, R.L., Kapoor, I.P., Lu, P.Y., Schuth, C.K., Sherman, P., 1973
Model ecosystem studies on the environmental fate of six organochlorine pesticides.
Environ. Health Perspect. 4: 35-44
- Naqvi, S.M., Ferguson, D.E., 1970
Levels of insecticide resistance in fresh water shrimp, *Palaemonetes kadiakensis*.
Trans. Am. Fish. Soc. 99(4): 696-699

Pawar, K.R., Katdare, M., 1983

Acute toxicity of Sumithion, BHC and Furadan to some selected fresh water organism.
Biovigyanam (Journal of life science (Poona)) 9: 67-72

PSM-Datenbank (PSM database),

Umweltbundesamt (Federal Environmental Agency), Berlin

Sanders, H.O., 1972

Toxicity of some insecticides to four species of *Malacostracan crustaceans*.

Tech. Paper No. 66, Bur. Sport Fish. Wildl., Fish Wildl. Serv., U.S.D.I.: 19 p.

Schimmel, S.E., Patrick, J.M. Jr., Forrester, J., 1977

Toxicity and bioconcentration of BHC and lindane in selected estuarine animals.

Arch. Environ. Contam. Toxicol. 6: 355 - 363

Schäfer, H., Hettler, H., Fritsche, U., Pitzen, G., Röderer, G., Wenzel, A., 1994

Biotests using unicellular algae and ciliates for predicting long-term effects of toxicants.

Ecotoxicol. Environ. Saf. 27: 64-81

Schulz, R., Liess, M., 1995

Chronic effects of low insecticide concentrations on freshwater caddisfly larvae.

Hydrobiologia 299: 103 - 113

Shim, J.C., Self, L.S., 1973

Toxicity of agricultural chemicals to larvivorous fish in Korean rice fields.

Trop. Med. 15 (3): 123-130

Shirley, M.A., McKenney, C.L.Jr., 1987

Influence of lindane on survival and osmoregulatory / metabolic responses of the laevae and adults of the estuarine crab, *Eurypanopeus depressus*.

EPA 600-D-87-261, in: W.B.Verberg, et al., (Eds.), Pollution and physiology of estuarine organisms, University of South Carolina Press: 275 - 297

Stephenson, R.R., 1983

Effects of water hardness, water temperature, and size of the test organism on the susceptibility of the freshwater shrimp, *Gammarus pulex* (L.), to toxicants.

Bull. Environ. Contam. Toxicol. 31 (4): 459-466

Taylor, E.J., Maund, S.J., Pascoe, D., 1991

Toxicity of four common pollutants to the freshwater macroinvertebrates *Chironomus riparius* Meigen (Insecta: Diptera) and *Gammarus pulex* (L.) (Crustacea: Amphipoda).

Arch. Environ. Contam. Toxicol. 21: 371-376

Taylor, E.J., unpublished

In: Taylor et al., 1991

Arch. Environ. Contam. Toxicol. 21: 371-376

Tscheu-Schlüter, M., Skibba, W.D., 1986

Vergleichende aquatotoxikologische Ergebnisse mit ausgewählten Wasserschadstoff-Gruppen und repräsentativen Wasserorganismen.

Acta hydrochim. hydrobiol. 14: 627-641

Federal Environmental Agency, 1995

Fachgespräch Umweltchemikalien mit endokriner Wirkung, Berlin 9. – 10. März 1995

Umweltbundesamt, Fraunhofer Institut für Umweltchemie und Ökotoxikologie, Abt.

Biochemische Ökotoxikologie;

UBA-Texte 65/95,

Zambriborshch, F.S., Lay, B., 1976

Effect of lindane on the survival time of fry of *Makropodus opercularis*.

Hydrobiological Journal 12(1): 100-102

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 $F1 = 0.1$.

($QT = 2.5 \text{ µg/l} \times 0.1 = 0.25 \text{ µg/l}$, rounded $QT = 0.3 \text{ µg/l}$).

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

5. Bibliography

BBA, 1993

Wirkstoffdatenblatt Linuron (Entwurf)

BBA / 0071 / 93 / 09

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

BBA, 1998

Liste der Wirkstoffe der zugelassenen Pflanzenschutzmittel

www.bba.de, Phytomed-Datenbank

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

Lysak, A., Marcinek, J., 1972

Multiple Toxic Effect of Simultaneous Action of Some Chemical Substances on Fish.

Roczniki Nauk Rolniczych 94 (3) 53-63

PSM-Datenbank (PSM database),

Umweltbundesamt (Federal Environmental Agency), Berlin

Stephenson, R.R., Kane, D.F., 1984

Persistence and Effects of Chemicals in Small Enclosures in Ponds.

Arch. Environm. Toxicol. 13, 313-326

U.S. EPA, Office of Pesticide Programs, 1995

Environmental Effects Database (EEDB).

Environmental Fate and Effects Division, U.S. EPA, Washington, D.C.

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 $F1 = 0.1$.

($QT = 0.15 \text{ µg/l} \times 0.1 = 0.015$, 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 coeruleus	residue	7 d	BCF	37.8	Tsuda et al. 1989

5. Bibliography

BBA, 1998

Liste der Wirkstoffe in zugelassenen Pflanzenschutzmitteln

www.bba.de, Phytomed-Datenbank

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

Becker, B., Gorge, G., Kalsch, W., Zok, S., Nagel, R., 1990

Aufnahme, Metabolismus, Elimination und Toxizität von aromatischen Aminen beim Zebrabärbling, *Brachydanio rerio*.

Forschungsbericht 106 03 053/02, Umweltbundesamt, Berlin, Deutschland

Bhatia, H.L., 1971

Toxicity of some pesticides to *Puntius ticto* (Hamilton).

Science and Culture 37: 160-161

Bulich, A.A., 1979

Use of luminescent bacteria for determining toxicity in aquatic environments.

Aquatic Toxicology, ASTM STP 667, L.L. Marking and R. A. Kimerle, Eds., American Society for Testing and Materials, pp. 98-106

Bulich, A.A., Greene, M.W., Isenberg, D.L., 1981

Reliability of the bacterial luminescence assay for determination of the toxicity of pure compounds and complex effluents.

Aquatic Toxicology and Hazard Assessment: Fourth Conference, ASTM STP 737, D. R. Branson and K. L. Dickson, Eds., American Society for Testing and Materials, pp. 338-347

Christie, A.E., 1969

Effects of insecticides on algae.

Water Sewage Works 116 (5): 172-176

Crosby, D.G., Tucker, R.K., Aharonson, N., 1966

The detection of acute toxicity with *Daphnia magna*.

Food and Cosmetic Toxicology 4: 503-514

Dortland, R.J., 1980

Toxicological evaluation of parathion and azinphosmethyl in freshwater model ecosystems.

Agric. Res. Rep. (Versl. landbouwk. Onderz.) 898, 112 p.

Dutta, H.M., Nasar, S.S.T., Munshi, J.S.D., Richmonds, C.R., 1992

Malathion induced changes in the optomotor behavior of an Indian carp, *Labio rohita*.

Bull. Environ. Contam. Toxicol. 49: 562-568

Frear, D.E.H., Boyd, J.E., 1967

Use of *Daphnia magna* for the microbioassay of pesticides. I. Development of standardized techniques for rearing daphnia and preparing of dosage-m...

J. Econ. Entomol. 60 (5): 1228-1236

Haider, S., Inbaraj, R.M., 1986

Relative Toxicity of technical material and commercial formulation of malathion and endosulfan to a freshwater fish, *Channa punctatus* (Bloch).

Ecotoxicol. Environ. Saf. 11 (3): 347-351

Hermanutz; R.O., 1978

Endrin and malathion toxicity to flagfish (*Jordanella floridae*).

Arch. Environ. Contam. Toxicol. 7: 159-168

Hermanutz; R.O., Eaton, J.G., Mueller, L.H., 1985

Toxicity of endrin and malathion mixtures to flagfish (*Jordanella floridae*).

Arch. Environ. Contam. Toxicol. 14:307-314

Katz, M., 1961

Acute toxicity of some organic insecticides to three species of salmonids and to the threespine stickleback.

Trans. Am. Fish. Soc. 90 (3). 264-268

Kennedy, H.D., Walsh, D.F., 1970

Effects of malathion on two warmwater fishes and aquatic invertebrates in ponds.

Techn. Paper 55, Bureau of Sport Fish. Wildl., Fish Wildl. Serv., U.S.D.I., Wash, D.C., 13 p.

Mayer, F.L., Ellersieck, M.R., 1986

Manual of acute toxicity: Interpretation and data base for 410 chemicals and 66 species of freshwater animals.

Resource Publication 106, Fish and Wildlife Service, U.S.D.I., Wash. D. C., 508 p., NTIS PB 86-239878

Moore, R.B., 1970

Effects of pesticides on growth and survival of *Euglena gracilis*.

Bull. Environ. Contam. Toxicol. 5: 226-231

Naqvi, S.M., Hawkins, R.H., 1989

Responses and LC₅₀ values for selected microcrustaceans exposed to spartan®, malathion, sonar®, weedtrine-D® and oust® pesticides.

Bull. Environ. Contam. Toxicol. 43: 386-393

- Netrawali, M.S., Gandhi, S.R., Pednekar, M.D., 1986
Effect of endosulfan, malathion, and permethrin on sexual life cycle of *chlamydomonas*.
Bull. Environ. Contam. Toxicol. 36: 412-420
- PSM-Datenbank (PSM database),
Umweltbundesamt (Federal Environmental Agency), Berlin
- Richmonds, C.R., Dutta, H.M., 1992
Effect of malathion on the brain acetylcholinesterase activity of bluegill sunfish *Lepomis macrochirus*.
Bull. Environ. Contam. Toxicol. 49: 431-435
- Sanders, H.O., 1969
Toxicity of pesticides to the crustacean *Gammarus lacustris*.
Tech. Paper No. 25, Bur. Sport Fish. Wildl., Fish Wildl. Serv., U.S.D.I.: 18 p.
- Sanders, H.O., 1970
Pesticide toxicities to tadpoles of the western chorus frog *Pseudacris triseriata* and Fowler's toad *Bufo woodhousii fowleri*.
Copeia 2: 246-251
- Sanders, H.O., 1972
Toxicity of some insecticides to four species of malacostracan crustaceans.
Tech. Paper No. 66, Bur. Sport Fish. Wildl., Fish Wildl. Serv., U.S.D.I.: 19 p.
- Schulte, C., Nagel, R., 1994
Testing acute toxicity in the embryo of zebrafish, *Brachydanio rerio*, as an alternative to the acute fish test: preliminary results.
ATLA (Alternatives to Laboratory Animals) 22: 12-19
- Sinha, N., Lal, B., Singh, T.P., 1992
Thyroid physiology impairment by malathion in the freshwater catfish *Clarias batrachus*.
Ecotoxicol. Environ. Saf. 24: 17-25
- Smith, J.W., Sotirios G. Grigoropoulos, 1968
Toxic effects of odorous trace organics.
J. Am. Water Works Assoc. 60: 969-979
- Tandon, R.S., Lal, R., Rao, V.V.S.N., 1987
Effects of malathion and endosulfan on the growth of *Paramecium aurelia*.
Acta Protozoologica 26: 325-328
- Tandon, R.S., Lal, R., Rao, V.V.S.N., 1988
Interaction of endosulfan and malathion with blue-green algae *Anabaena* and *Aulosira fertilissima*.
Environ. Poll. 52: 1-9

Tchounwou, P.B., Englande, A.J., 1992

The Effects of bayluscide and malathion on the mortality and infectivity of *Schistosoma mansoni* cercariae.

Environmental Toxicology and Water Quality: An International Journal 7: 107-117

Tsuda, T., Aoki, S., Kojima, M., Harada, H., 1989

Bioconcentration and excretion of diazinon, IBP, malathion and fenitrothion by willow shiner.

Toxicol. Environ. Chem. 24: 185-190

Tsuda, T., Aoki, S., Kojima, M., Harada, H., 1990

Bioconcentration and excretion of diazinon, IBP, malathion and fenitrothion by carp.

Comp. Biochem. Physiol. 96 C (1): 23-26

Weiss, C.M., Gakstatter, J.H., 1964

Detection of pestidides in water by biochemical assay.

Journal Water Poll. Control. Fed. 36 (2): 240-253

Whitten, B.K., Goodnight, C.J., 1966

Toxicity of some common insecticide to tubificids.

J. Water Pollut. Control Fed. 38 (2): 227-235

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 phenoxy-carboxylic acids. The mode of action of MCPA could not be fully clarified to date. Basically it influences the nucleic 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/m³) showed no adverse effects (BBA, 1993). In view of the bacteria test results of 2,4-D (phenoxy-carboxylic 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 $F1 = 0.1$.
($QT = 20 \mu\text{g/l} \times 0.1 = 2.0 \mu\text{g/l}$).

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	Knappek & 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

5. Bibliography

Ahmed, W., 1977

The Effectiveness of Predators of Rice Field Mosquitoes in Relation to Pesticide Use in Rice Culture.

Ph.D. Thesis, University of California, Davis, CA:56 p.; Dissert. Abstr. Int. B 379:430B

BBA, 1993

Wirkstoffdatenblatt MCPA, Stand 14.07.93.

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

BBA, 1998

Liste der Wirkstoffe in zugelassenen Pflanzenschutzmitteln

www.bba.de, Phytomed-Datenbank

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

Bernardini, G., Spinelli, O., Visnara, C., 1996

Evaluation of the developmental toxicity of the pesticide MCPA and its contaminants phenol and chlorocresol.

Environmental Toxicology and Chemistry, Vol. 15, No. 5, pp. 754-760

Caux, P.Y., Kent, R.A., Bergeron, V., Fan, G.T., MacDonald, D.D., 1995

Environmental fate and effects of MCPA: A Canadian perspective.

Critical Reviews in Environmental Science and Technology, 25(4): 313-376

CCME- Canadian Council of Ministers of the Environment, 1995

Canadian water quality guidelines: Updates March 1995 Appendix XVIII.

Environment Canada, Ottawa, Canada

Crosby, D.G., Tucker, R.K., 1966

Toxicity of Aquatic Herbicides to *Daphnia magna*

Science 154:289-290

- Davies, P.E., Cook L.S., Goenarso, D., 1994
Sublethal responses to pesticides of several species of australian freshwater fish and crustaceans and rainbow trout.
Environmental Toxicology and Chemistry, Vol. 13, No 8, pp. 1 341-1354
- Davis, J.T., Hughes, J.S., 1963
Further Observations on the Toxicity of Commercial Herbicides to Bluegill Sunfish.
Proc. South. Weed Conf. 16:337-340 Used Ref 612
- Fargasova, A., 1994
Comparative study of plant growth hormone Herbicide toxicity in various biological subjects.
Ecotoxicology and Environmental Safety 29, 359-364
- Johnson, W.W., Finley, M.T., 1980
Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates.
Resour. Publ. 137, Fish Wildl. Serv., U.S.D.I., Washington, D.C.:98 p.
- Hanstveit, A.O. 1988
Effects of U 46 M-Fluid on growth of the algae *Selenastrum capricornutum*.
TPH Report No: R 88/421 (Angaben: Industrieverband Agrar e.V., Frankfurt)
- Koch & Memmert 1993
Toxicity of herbicide Marks M to *Pseudokirchneriella subcapitata*.
AH Marks, Report No. RCC 409050 (Angaben: Industrieverband Agrar e.V., Frankfurt)
- Knapek, R. Lakota, S., 1974
Einige Biotests zur Untersuchung der toxischen Wirkung von Pestiziden im Wasser. Biological Testing to Determine Toxic Effects of Pesticides.
In: Akad. Landwirtschaftswiss. D.D.R. (editor), 1977: Tagungsbericht No. 126:105-109
- Lysak, A., Marcinek, J., 1972
Multiple Toxic Effect of Simultaneous Action of Some Chemical Substances on Fish.
Rocz. Nauk Roln. Ser. H Rybactwo 943:53-63
- Nishiuchi, Y., Hashimoto, Y., 1967
Toxicity of Pesticide Ingredients to Some Fresh Water Organisms.
Botyu-Kagaku Sci. Pest Control 321:5-11 JPN ENG ABS. Author Communication Used
- Nishiuchi, Y., Hashimoto, Y. 1969
Toxicity of Pesticides to Some Fresh Water Organisms.
Rev. Plant Protec. Res. 2:137-139
- Peterson, H.G., Boutin, C., et al., 1994
Aquatic phyto-toxicity of 23 pesticides applied at Expected Environmental Concentrations.
Aquatic Toxicology 28 1994 275-292
- PSM-Datenbank (PSM database),
Umweltbundesamt (Federal Environmental Agency), Berlin

Tscheu-Schlüter, M.; Skibba, W.D. 1986

Vergleichende aquatoxische Ergebnisse mit ausgewählten Schadstoff-Gruppen und repräsentativen Wasserorganismen

Acta hydrochim. hydrobiol. 14, , 6, 627-641.

UNEP/IRPTC International Register of Potentially Toxic Chemicals, 1990

United Nations Environment Programme/ International Register of Potentially Toxic, Genf

Woin, P., Brönmark, C., 1992

Effect of DDT and MCPA 4-Chloro-2-Methylphenoxyacetic Acid on Reproduction of the Pond Snail, *Lymnaea stagnalis* L.

Bull. Environm. Contam. Toxicol. 1992 48:7-13

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 phenoxy-carboxylic acids. Its mode of action is basically characterized by an inhibition of the nucleic 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 phenoxy-carboxylic 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 phenoxy-carboxylic 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					
<i>Scenedesmus subspicatus</i>	abundance	4 d	EC50	102660	Kirby & Sheahan 1994
Aquatic plants					
<i>Lemna minor</i>	number of leaflets	10 d	EC50	5147	Kirby & Sheahan 1994
Fish					
<i>Anguilla japonica</i>	mortality	2 d	LC50	> 100000	Yokoyama et al. 1988
<i>Rasbora heteromorpha</i>	mortality	1 d	LC50	12000	Alabaster 1969
<i>Rasbora heteromorpha</i>	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

5. Bibliography

Alabaster, J.S., 1969

Survival of Fish in 164 Herbicides, Insecticides, Fungicides, Wetting Agents and Miscellaneous Substances.

Int. Pest Control 11(2):29-35 (Author Communication Used)

BBA, 1993

Wirkstoffdatenblatt Mecoprop (Entwurf).

Biologischen Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

BBA, 1998

Verzeichnis zugelassener Pflanzenschutzmittel.

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

Kirby, M.F., Sheahan, D.A., 1994

Effects of Atrazine, Isoproturon, and Mecoprop on the Macrophyte *Lemna minor* and the Alga *Scenedesmus subspicatus*.

Bull. Environ. Contam. Toxicol. 53(1):120-126

Linden, E., Bengtsson, B.E., Svanberg, O., Sundstrom, G., 1979

The Acute Toxicity of 78 Chemicals and Pesticide Formulations Against Two Brackish Water Organisms, the Bleak (*Alburnus alburnus*) and the Harpacticoid.

Chemosphere 8(11/12):843-851 (Author Communication Used)

PSM-Datenbank (PSM database),

Umweltbundesamt (Federal Environmental Agency), Berlin

U.S. EPA Office of Pesticide Programs, 1995

Environmental Effects Database (EEDB).

Environmental Fate and Effects Division, U.S. EPA, Washington, D.C.

Yokoyama, T., Saka, H., Fujita, S., Nishiuchi, Y., 1988
Sensitivity of Japanese Eel, *Anguilla japonica*, to 68 Kinds of Agricultural Chemicals.
Bull. Agric. Chem. Insp. Stn. 28:26-33 (JPN) (ENG ABS)

Metazachlor2-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 × 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 bibrarianus*). 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
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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 bibrarianus	no data	3 d	NOEC	80	PSM database 1991
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5. Bibliography

Faust, M., Altenburger, R., Boedeker, W., Grimme, 1993
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

BBA, 1998

Liste der Wirkstoffe in zugelassenen Pflanzenschutzmitteln

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 $F1 = 0.1$.
($QT = 18 \text{ µg/l} \times 0.1 = 1.8 \text{ µg/l}$, 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

5. Bibliography

BBA, 1998

Liste der Wirkstoffe in zugelassenen Pflanzenschutzmitteln.

www.bba.de, Phytomed-Datenbank

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

Bringmann, G., Kühn, R., 1975

Wirkung herbizider Phenylharnstoff-Derivate gegen Blaualgen (Modellorganismen:

Microcystis aeruginosa bzw. *Nostoc spec.*).

gwf - wasser / abwasser 116, H. 8, 366-369

Faust, M., Altenburger, R., Boedeker, W., Grimme, 1993

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),

Umweltbundesamt (Federal Environmental Agency), Berlin

Metolachlor2-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 $F1 = 0.1$.

($QT = 2 \text{ µg/l} \times 0.1 = 0.2 \text{ µg/l}$). 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
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Metabolite CGA 40172

Bacteria

Sewage sludge bacteria	no data		EC20	100000	PSM database 1991
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5. Bibliography

BBA, 1998

Liste der Wirkstoffe in zugelassenen Pflanzenschutzmitteln

www.bba.de, Phytomed-Datenbank

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

BBA, 1993

Wirkstoffdatenblatt Metolachlor (Entwurf)

BBA / 0422 / 93 / 7

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

PSM-Datenbank (PSM database),

Umweltbundesamt (Federal Environmental Agency), Berlin

U.S. EPA, Office of Pesticide Programs, 1995

Environmental Effects Database (EEDB).

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 $F1 = 0.1$. ($QT = 0.05 \text{ µg/l} \times 0.1 = 0.005 \text{ µg/l}$). 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
Orconectes 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	emer- gence 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

5. Bibliography

BBA, 1998

Liste der Wirkstoffe in zugelassenen Pflanzenschutzmitteln

www.bba.de, Phytomed-Datenbank

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

BBA, 1993

Wirkstoffdatenblatt Parathion-ethyl, Stand 14.07.93

BBA/0087/93/09

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

Bringmann, G., Kühn, R., 1977

Grenzwerte der Schadwirkung wassergefährdender Stoffe gegen Bakterien (*Pseudomonas putida*) und Grünalgen (*Scenedesmus quadricauda*) im Zellvermehrungshemmtest.

Z. f. Wasser- und Abwasser-Forschung 10. Jhg. Nr. 3/4/77: 87-98

Bringmann, G., Kühn, R., 1978

Grenzwerte der Schadwirkung wassergefährdender Stoffe gegen Blaualgen (*Microcystis aeruginosa*) und Grünalgen (*Scenedesmus quadricauda*) im Zellvermehrungshemmtest.

Vom Wasser Vol. 50: 45-60

Dortland, R.J., 1980

Toxicological evaluation of parathion and azinphosmethyl in freshwater model ecosystems. Agric. Res. Rep. (Versl. landbouwk. Onderz.) 898, 112 p.

Frear, D.E.H., Boyd, J.E., 1967

Use of *daphnia magna* for the microbioassay of pesticides. I. Development of standardized techniques for rearing daphnia and preparing of dosage...

J. Econ. Entomol. 60 (5): 1228-1236

Johnson, W.W., Finley, M.T., 1980

Handbook of acute toxicity of chemicals to fish and aquatic invertebrates.

Resour. Publ. 137, Fish Wildl. Serv., U.S.D.I., Washington D.C., 98 p

Matthias, U., 1990

Ökotoxikologische Bewertung des SANDOZ-Schadenfalles anhand von Laboruntersuchungen; So.pj.: „Ökologische Schäden im Rhein durch den SANDOZ-Schadensfall“.

Landesanstalt für Umweltschutz Baden-Württemberg, Karlsruhe

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

Sanders, H.O., 1972
Toxicity of some insecticides to four species of malacostracan crustaceans.
Tech. Paper No. 66, Bur. Sport Fish. Wildl., Fish Wildl. Serv., U.S.D.I.: 19 p.

Schiedsanalyse Bundesgesundheitsamt (bga), 1994
Ökotoxizität von Parathion-Ethyl, 21-Tage Reproduktionstest mit *Daphnia magna*
durchgeführt durch das Institut für Wasser-, Boden- und Lufthygiene, Berlin

Schulz, R., Liess, M., 1995
Chronic effects of low insecticide concentrations on freshwater caddisfly larvae
Hydrobiologica 299: 103 - 113

Somasunderam, L., Coats, J.R., Racke, K.D., Stahr, H.M., 1990
Application of the Microtox system to assess the toxicity of pesticides and their hydrolysis
metabolites.
Bull. Environ. Contam. Toxicol. 44: 254-259

Spacie, A., 1976
Acute and chronic parathion toxicity to fish and invertebrates.
EPA, Wash., D.C., Office of Research and Monitoring, 77 p., NTIS PB-257 800

Spacie, A., Vilkas, S.G., Doebbler, G.F., Kuc, W.J., Iwan, G.R., 1981
Acute and chronic parathion toxicity to fish and invertebrates.
EPA-600/3-81-047, Wash., D.C., Office of Research and Monitoring, 79 p., NTIS PB81-
245862

UBA-Texte 65/95, 1995
Fachgespräch Umweltchemikalien mit endokriner Wirkung

US EPA, 1995
Office of Pesticide Programs, Environmental Effects Database (EEDB)
Environmental Fate and Effects Division, US EPA, Washington, D.C.

Van Leeuwen, C.J., Griffioen, P.S., Vergouw, W.H.A., Maas-Diepeveen, J.L., 1985
Differences in susceptibilities of early life stages of rainbow trout (*salmo gairdneri*) to
environmental pollutants.
Aquatic Toxicology 7. 59-78

Weiss, C.M., Gakstatter, J.H., 1964
Detection of pesticides in water by biochemical assay.
Journal Water Poll. Control. Fed. 36 (2): 240-253

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 $F1 = 0.1$. ($QT = 0.18 \mu\text{g/l} \times 0.1 = 0.018 \mu\text{g/l}$, 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					
<i>Pseudomonas putida</i>	cell multiplication	18 h	EC 10 >	34000	Trenel et al. 1982
Algae					
<i>Chlorella reinhardi</i>	cell multiplication	4 d	NOEC	220	Schäfer et al. 1994
<i>Chlorella reinhardi</i>	cell multiplication	7 d	NOEC	830	Schäfer et al. 1994
<i>Chlorella reinhardi</i>	cell multiplication	10 h	NOEC	1450	Schäfer et al. 1994
<i>Chlorella reinhardi</i>	cell multiplication	3 d	NOEC >	100000	Schäfer et al. 1994
<i>Chlorella vulgaris</i>	no data	4 d	EC 50	5300	BBA./0088/93/03
<i>Scenedesmus subspicatus</i>	cell multiplication	7 d	EC 3	2600	Trenel et al. 1982
<i>Scenedesmus subspicatus</i>	cell multiplication	4 d	NOEC	100	PSM database
<i>Scenedesmus subspicatus</i>	cell multiplication	4 d	EC 50	3000	PSM database
<i>Scenedesmus subspicatus</i>	cell multiplication	3 d	NOEC	8000	Schäfer et al. 1994
<i>Scenedesmus subspicatus</i>	cell multiplication	3 d	EC 50	15000	Schäfer et al. 1994
Crustaceans					
<i>Daphnia magna</i>	reproduction	21 d	NOEC	0.18	PSM database
<i>Daphnia magna</i>	mortality	21 d	LOEC	0.56	PSM database
<i>Daphnia magna</i>	immobilization, reproduction	21 d	NOEC	1.2	Dortland. 1980
<i>Daphnia magna</i>	mortality	2 d	LC 50	8.0	Dortland. 1980
<i>Daphnia magna</i>	immobilization	2 d	EC 50	0.14	Johnson & Finley 1980
<i>Daphnia magna</i>	mortality	2 d	LC 50	0.14	Mayer & Ellersieck 1986
<i>Daphnia magna</i>	no data	2 d	NOEC	3.2	PSM database
<i>Daphnia magna</i>	no data	2 d	LOEC	5.6	PSM database
<i>Daphnia magna</i>	mortality	2 d	LC 50	7.3	PSM database
<i>Daphnia magna</i>	mortality	2 d	LC 50	12	Oikari et al. 1992
<i>Daphnia magna</i>	immobilization	1 d	EC 50	4.6	Trenel et al. 1982
<i>Daphnia magna</i>		1 d	LC 50	4.8	Frear & Boyd 1967
<i>Daphnia magna</i>			LC 50	4.8	Kenaga 1979
<i>Gammarus fasciatus</i>	immobilization	4 d	EC 50	3.8	Johnson & Finley 1980
<i>Mysidopsis bahia</i>	mortality	4 d	MAT C	0.11	Nimmo et al. 1981

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

5. Bibliography

- Auwarter, A.G., 1977
Some effects of toxaphene methyl-parathion interaction on bluegill sunfish (*Lepomis macrochirus* Rafinesque).
Ph.D. Thesis, University of Georgia, Athens Diss. Abstr. Int. B. 38 (7) 3061 (1978)
- BBA, 1998
Liste der Wirkstoffe in zugelassenen Pflanzenschutzmitteln
www.bba.de, Phytomed-Datenbank
Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig
- BBA, 1993
Wirkstoffdatenblatt Parathion-methyl, Entwurf
BBA/0088/93/03,
Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig
- Bhattacharya, S., 1993
Target and non-target effects of anticholinesterase pesticides in fish.
The Science of the Total Environment, Supplement 1993: 859-866
- Brandt, O.M., Fujimura, R.W., Finlayson, B.J., 1993
Use of *Neomysis mercedis* (Crustacea: Mysidacea) for estuarine toxicity tests.
Trans. Am. Fish. Soc. 122 (2): 279 - 288
- Carter, F.L., Graves, J.B., 1972
Measuring effects of insecticides on aquatic animals.
La Agric. 16 (2): 14-15
- Crossland, N.O., Bennett, D., 1984
Fate and biological effects of methyl parathion in outdoor ponds and laboratory aquaria. II. Fates.
Ecotoxicol. Environ. Saf. 8 (5): 471-481
- Dörtland, R.J., 1980
Toxicological evaluation of parathion and azinphosmethyl in freshwater model ecosystems.
Agric. Res. Rep. (Versl. landbouwk. Onderz.) 898, 112 p.
- Fernández-Casalderry, A., Ferrando, M.D., Andreu-Moliner, E., 1993
Effect of the insecticide methylparathion on filtration and ingestion rates of *Brachionus calyciflorus* and *Daphnia magna*.
The Science of the Total Environment, Supplement 1993: 867-876
- Frear, D.E.H., Boyd, J.E., 1967
Use of *Daphnia magna* for the microbioassay of pesticides. I. Development of standardized techniques for rearing daphnia and preparing of dosage...
J. Econ. Entomol. 60 (5): 1228-1236

- Henry, M.G., Atchinson, G.J., 1984
Behavioral effects of methyl parathion on social groups of bluegill (*Lepomis macrochirus*).
Environ. Toxicol. Chem. 3: 399-408
- Hirayama, K., Tamaoi, S., 1980
Acute toxicity of methylparathion and diazinon (pesticide) to larvae of kumura prawn
Penaeus japonicus and of swimming crab *Portunus trituberculatus*.
Bull. Jpn. Soc. Sci. Fish. 46: 117- 123
- Jarvinen, A.W., Tanner, D.K., 1982
Toxicity of selected controlled release and corresponding unformulated technical grade
pesticide to the fathead minnow *Pimephales promelas*.
Environ. Poll. (Series A) 27: 179-195
- Johnson, W.W., Finley, M.T., 1980
Handbook of acute toxicity of chemicals to fish and aquatic invertebrates.
Resour. Publ. 137, Fish. Wildl. Serv., U.S.D.I., Wash. D.C., 98 p.
- Kenaga, E.E., 1979
Acute and chronic toxicity of 75 pesticides to various animal species.
Down to Earth 35: 25-31
- Maheshwari, U.K., Das, B.C., Paul, S., Chouhan, S.K., Yadav, A.K., 1988
Bioassay studies of some commercial organic pesticides to an exotic carp fry,
Hypophthalmichthys molitrix (C. & V.).
J. Environ. Biol. 9 (4): 377-380
- Mayer, F.L., Jr., Ellersieck, M.R., 1986
Manual of acute toxicity: interpretation and data base for 410 chemicals and 66 species of
freshwater animals.
Washington, D.C., US Department of the Interior Fish and Wildlife Service, pp. 311
- Naqvi, S.M., Ferguson, D.E., 1970
Levels of insecticide resistance in fresh-water shrimp, *Palaemonetes kadiakensis*.
Trans. Am. Fish. Soc. 99 (4): 696-699
- Nimmo, W.R., Hamaker, T.L., Matthews, E., Moore, J.C., 1981
An overview of the acute and chronic effects of first and second generation pesticides on an
estuarine mysid. In: Vernberg, F.J., A. Calabresa, F.P. Thurberg and W.B. Vernberg, ed.
Biological monitoring of marine pollutants. Proceedings of a symposium on pollution and
physiology of marine organisms, Milford, Connecticut, 7-9 November 1980.
New York, London, Academic Press, pp. 3 - 19
- Oikari, A., Kukkonen, J., Virtanen, V., 1992
Acute toxicity of chemicals to *Daphnia magna* in humic waters.
The Science of the Total Environment 117/118: 367-377

- Pal, A.K., Konar, S.K., 1990
Pollution of aquatic ecosystem by pesticide methyl parathion.
Environment & Ecology 8(3): 906-912
- PSM-Datenbank (PSM database),
Umweltbundesamt (Federal Environmental Agency), Berlin
- Rao, K.S.P., Rao, K.V.R., 1983
Regulation of phosphorylases and aldolases in tissues of the teleost (*Tilapia mossambica*)
under methyl parathion impact.
Bull. Environ. Contam. Toxicol. 31: 474-478
- Schäfer, H., Hettler, H., Fritsche, U., Pitzén, G., Röderer, G., Wenzel, A., 1994
Biotests using unicellular algae and ciliates for predicting long-term effects of toxicants.
Ecotoxicol. Environ. Saf. 27: 64-81
- Shim, J.C., Self, L.S., 1973
Toxicity of agricultural chemicals to larvivorous fish in Korean rice fields.
Tropical Medicine 15 (3): 123-130
- Singh, N.N., Srivastava, A.K., 1982
Toxicity of a mixture of aldrin and formothion and other organophosphorus, organochlorine
and carbamate pesticides to the Indian catfish, *Heteropneustes fossilis*.
Comp. Physiol. Ecol. 7 (2) B: 115-118, 9 (1) B: 63-66 (1984)
- Trenel, J., Kühn, R., 1982
Bewertung wassergefährdender Stoffe
UFO-Plan des BMI und des UBA, F+E-Nr. 102 04 059 und F+E-Nr. 102 03 202
- Weiss, C.M., Gakstatter, J.H., 1964
Detection of pesticides in water by biochemical assay.
Journal Water Poll. Control. Fed. 36 (2): 240-253

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 $F1 = 0.1$.

($QT = 5 \text{ µg/l} \times 0.1 = 0.5 \text{ µg/l}$). 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					
<i>Pseudomonas putida</i>		3 d	NOEC	11250	Bruns & Knacker 1998
<i>Rhizobium japonicum</i>	growth	26.25 h	TC ≤	6.8	Yee et al. 1985
Algae					
<i>Chlamydomonas segnis</i>	growth	14 h	TC ≤	0.75	Yee et al. 1985
<i>Navicula pelliculosa</i>	no data	5 d	EC50	1	EPA 1995
<i>Ankistrodesmus falcatus</i>	growth	12 d	NOEC	5	Tscheu-Schlüter 1976
<i>Ankistrodesmus falcatus</i>	growth	12 d	LOEC	8	Tscheu-Schlüter 1976
<i>Ankistrodesmus falcatus</i>	growth	12 d	EC50	20	Tscheu-Schlüter 1976
Plankton	assimilation	3 h	EC50	22	Brown & Lean 1995
Crustaceans					
<i>Daphnia magna</i>	immobilization	2 d	EC50	9700	Marchini et al. 1988
<i>Daphnia magna</i>	reproduction	21 d	LOEC	2000	EPA 1995
Fish					
<i>Penaeus duorarum</i>	mortality	2 d	LC50 >	1000	EPA 1995
<i>Pimephales promelas</i>	no data	28 d	LOEC	1200	EPA 1995
<i>Daphnia magna</i>	no data	21 d	LOEC	2000	EPA 1995
Plants					
<i>Lemna gibba</i>	no data	14 d	EC50	11.8	EPA 1995

5. Bibliography

BBA, 1998

Liste der Wirkstoffe in zugelassenen Pflanzenschutzmitteln

www.bba.de, Phytomed-Datenbank

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

Brown, L.S., Lean, D.R., 1995

Toxicity of Selected Pesticides to Lake Phytoplankton Measured Using Photosynthetic Inhibition Compared to Maximal Uptake Rates of Phosphate and Ammonium.

Environ. Toxicol. Chem. 14 (1), 93-98

Bruns, E., Knacker, Th., 1998

Untersuchung der Wirkung gefährlicher Stoffe auf aquatische Organismen zur Ableitung von Zielvorgaben

BMU, F+E-Vorhaben Nr.: 10601067

EPA, Office of Pesticide Programs, 1995

Environmental Effects Database (EEDB).

Environmental Fate and Effects Division, U.S. EPA, Washington, D.C.

Marchini, S., Passerini, L., Cesareo, D., Tosato, M.L., 1988

Herbicidal Triazines: Acute Toxicity on Daphnia, Fish, and Plants and Analysis of its Relationships with Structural Factors.

Ecotoxicol. Environ. Saf. 16 (2), 148-157

Tscheu-Schlüter, M., 1976

Zur akuten Toxizität von Herbiziden gegenüber ausgewählten Wasserorganismen.

Teil 2: Triazinherbizide und Amitrol

Acta hydrochim. hydrobiol. 4 (2): 153-170

Yee, P., Weinberger, P., Johnson, D.A., DeChacin, C., 1985

In Vitro Effects of the s-Triazine Herbizide, Prometryn, on the Growth of Terrestrial and Aquatic Microflora.

Arch. Environ. Contam. Toxicol. 14, 25-31

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:
 $(QT = 11 \mu\text{g/l} \times 0.1 \times 0.1 = 0.11 \mu\text{g/l, rounded } 0.1 \mu\text{g/l})$. 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
<i>Penaeus duorarum</i>	no data	4 d	EC 50	113000	PSM database
<i>Penaeus duorarum</i>	no data	1 d	EC 50	452000	PSM database
Fish					
<i>Cyprinus carpio</i>	mortality	4 d	LC 50 >	100000	PSM database
<i>Cyprinus carpio</i>	no data	4 d	NOEC ≥	34000	PSM database
<i>Cyprinus carpio</i>	mortality	4 d	LC 50 >	34000	PSM database
<i>Ictalurus melas</i>	mortality	4 d	LC 50	65000	PSM database
<i>Ictalurus melas</i>	mortality	2 d	LC 50	80000	PSM database
<i>Leuciscus idus melanotus</i>	mortality	4 d	LC 50	90000	PSM database
<i>Leuciscus idus melanotus</i>	mortality	2 d	LC 50 >	100000	PSM database
<i>Oncorhynchus mykiss</i>	growth rate	21 d	NOEC	3200	PSM database 1989
<i>Oncorhynchus mykiss</i>	growth rate	21 d	LOEC	5800	PSM database 1989
<i>Oncorhynchus mykiss</i>	mortality	21 d	NOEC	10000	PSM database 1989
<i>Oncorhynchus mykiss</i>	mortality	21 d	LOEC	18000	PSM database 1989
<i>Oncorhynchus mykiss</i>	no data	4 d	NOEC	10000	PSM database 1983
<i>Oncorhynchus mykiss</i>	mortality	4 d	LC > 100	100000	PSM database
<i>Oncorhynchus mykiss</i>	mortality	4 d	LC 50	70500	PSM database 1976
<i>Oncorhynchus mykiss</i>	no data	4 d	NOEC <	12000	PSM database 1976
<i>Oncorhynchus mykiss</i>	mortality	48	LC 50	56000	PSM database
<i>Poecilia reticulata</i>	mortality	96 d	LC 50	48000	PSM database
<i>Punctius ticto</i>	mortality	30 d	LC 50	1000	Upadhyaya & Rao 1980
<i>Punctius ticto</i>	mortality	16 d	LC 50	5000	Upadhyaya & Rao 1980
<i>Roccus saxatilis</i>	mortality	4 d	LC 50	312.5 ¹	Wellborne 1969
<i>Roccus saxatilis</i>	mortality	2 d	LC 50	550 ¹	Wellborne 1969
<i>Roccus saxatilis</i>	mortality	1 d	LC 50	750 ¹	Wellborne 1969
<i>Salmo gairdneri</i>	mortality	28 d	NOEC ≥	2500	Bathe et al. 1975
<i>Salmo gairdneri</i>	mortality	4 d	LC 50 >	100000	Bathe et al. 1975
<i>Salmo gairdneri</i>	mortality	2 d	LC 50	85000	Alabaster 1969
Other Species and/or Parameters					
Macrophytes					
<i>Lemna minor</i>	cell membrane permeability	12 h	TC	2000	O'Brian & Prendeville 1979
<i>Lemna gibba</i>		14 d	EC 50	0.14	US EPA 1995

¹ converted from 80 % to 100 % active ingredient

5. Bibliography

Alabaster, J.S., 1969

Survival of fish in 164 herbicides, insecticides, fungicides, wetting agents and miscellaneous substances.

Int. Pest Control 11 (2): 29-35

Bathe, R., Sachsse, K., Ullmann, L., Hormann, W.D., Zak, F., Hess, R., 1975

The evaluation of fish toxicity in the laboratory.

Proc. Eur. Soc. Toxicol. 16: 113-124

BBA, 1998

Liste der Wirkstoffe in zugelassenen Pflanzenschutzmitteln

www.bba.de, Phytomed-Datenbank

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

Beckmann, J., Tazik, P., Gordon, R., 1984

Effects of two herbicides on selected aquatic bacteria.

Bull. Environ. Contam. Toxicol. 32 (2): 243-250

Bednarz, T., 1981

The effect of pesticides on the growth of green and blue green algae cultures.

Acta Hydrobiol. 23 (2): 155-172

Fitzmayer, K.M., Geiger, J.G., Van Den Avyle, M.J., 1982a

Effects of chronic exposure to simazine on the cladoceran, *Daphnia pulex*.

Arch. Environ. Contam. Toxicol. 11 (5): 603-609

Fitzmayer, K.M., Geiger, J.G., Van Den Avyle, M.J., 1982b

Acute toxicity effects of simazine on *Daphnia pulex* and larval striped bass.

Proc. Ann. Conf. Southeast. Assoc. Fish. Wildl. Agencies 36: 146-156

George, J.P., Hingorani, H.G., Rao, K.S., 1982

Herbicide toxicity to fish-food organisms.

Environ. Poll. (Series A) 28: 183-188

Johnson, W.W., Finley, M.T., 1980

Handbook of acute toxicity of chemicals to fish and aquatic invertebrates.

Resour. Publ. 137, Fish. Wildl. Serv., U.S.D.I., Wash. D.C., 98 p.

Kommission zur Bewertung wassergefährdender Stoffe (KBwS), 1989

Datenblätter zum Katalog wassergefährdender Stoffe, Datenblatt Nr. 338 Simazin vom 27.08.1987

McFeter, G.A., Bond, P.J., Olson, S.B., Tchan, Y.T., 1983

A comparison of microbial bioassays for detection of aquatic toxicants.

Water Research 17 (12): 1757-1762

O'Brian, M.C., Prendeville, G.N., 1979

Effects of herbicides on cell membrane permeability in *Lemna minor*.

Weed Research 19: 331-334

PSM-Datenbank (PSM database),

Umweltbundesamt (Federal Environmental Agency), Berlin

Sanders, H.O., 1970

Toxicity of some herbicides to six species of freshwater crustaceans.

Journal WPCF 42 (8): 1544-1550

Turbak, S.C., Olsen, S.B., McFeters, G.A., 1986

Comparison of algal assay systems for detecting waterborne herbicides and metals.

Wat. Res. 20 (1): 91-96

UBA-Texte 65/95, 1995

Fachgespräch Umweltchemikalien mit endokriner Wirkung.

Umweltbundesamt, Berlin

Upadhyaya, A., Rao, K.S., 1980

Acute toxicity of tafazine to fish.

Int. J. Environ. Stud. 15 (3). 236-238

US EPA, 1995

Office of pesticide programs, Environmental Effects Database (EEDB)

Environmental fate and effects division US EPA, Washington, D.C.

Wellborn, T.L. Jr., 1969

The toxicity of nine therapeutic and herbicidal compounds to striped bass.

Prog. Fish-Cult. 31 (1): 27-32

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 $F1 = 0.1$.

($QT = 5.4 \text{ µg/l} \times 0.1 = 0.54 \text{ µg/l}$, rounded $QT = 0.5 \text{ µg/l}$). 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					
<i>Pseudomonas putida</i>	cell multiplication	3 d	NOEC	4000	Bruns & Knacker 1998
Algae					
<i>Scenedesmus subspicatus</i>	no data	5 d	NOEC	9.6	PSM database 1982
Plankton	growth	10 d	TC ≤	20	Shehata et al. 1993
Crustaceans					
<i>Daphnia magna</i>	reproduction	21 d	NOEC <	5.4	BBA 1993
<i>Daphnia magna</i>	reproduction	21 d	LOEC	13	BBA 1993
<i>Daphnia magna</i>	reproduction	21 d	NOEC	18	PSM database
<i>Daphnia magna</i>	reproduction	21 d	LOEC	55	PSM database
<i>Mysidopsis bahia</i>	mortality	4 d	LC50	110	EPA 1995
<i>Daphnia magna</i>	immobilization	21 d	NOEC	210	PSM database 1989
<i>Daphnia magna</i>	mobility	21 d	LOEC	210	PSM database
<i>Daphnia magna</i>	mobility	21 d	NOEC	210	PSM database
<i>Daphnia magna</i>	no data	2 d	NOEC <	10000	PSM database 1977
<i>Daphnia magna</i>	no data	2 d	EC50	21200	PSM database 1977
Fish					
<i>Oncorhynchus mykiss</i>	no data	21 d	NOEC	238	PSM database 1990
<i>Oncorhynchus mykiss</i>	no data	21 d	LOEC	950	PSM database 1990
<i>Poecilia reticulata</i>	no data	4 d	LC50	1600	PSM database

5. Bibliography

BBA, 1998

Liste der Wirkstoffe in zugelassenen Pflanzenschutzmitteln

www.bba.de, Phytomed-Datenbank

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

BBA, 1993

Wirkstoffdatenblatt (Entwurf) BBA / 0316 / 93 / 07

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

Bruns, E., Knacker, Th., 1998

Untersuchung der Wirkung gefährlicher Stoffe auf aquatische Organismen
zur Ableitung von Zielvorgaben

BMU, F+E-Vorhaben Nr. (Research Report) No.:10601067

EPA, Office of Pesticide Programs, 1995

Environmental Effects Database (EEDB).

Environmental Fate and Effects Division, U.S. EPA, Washington, D.C.

PSM-Datenbank (PSM database),

Umweltbundesamt (Federal Environmental Agency), Berlin

Shehata, S.A., El-Dib, M.A., Abou-Waly, H.F., 1993

Effect of Triazine Compounds on Freshwater Algae.

Bull. Environ. Contam. Toxicol. 50, 369-376

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 $F1 = 0.1$.

($QT = 0.32 \text{ µg/l} \times 0.1 = 0.032 \text{ µg/l}$, rounded $QT = 0.03 \text{ µg/l}$). 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

5. Bibliography

BBA, 1998

Liste der Wirkstoffe in zugelassenen Pflanzenschutzmitteln

www.bba.de, Phytomed-Datenbank

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

PSM-Datenbank (PSM database),

Umweltbundesamt (Federal Environmental Agency), Berlin

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 $F1 = 0.1$.

($QT = 0.3 \text{ µg/l} \times 0.1 = 0.03 \text{ µg/l}$). 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 carpicornutum	number of cells	4 d	ErC50	12.2	PSM database
Selenastrum carpicornutum	growth rate	4 d	ED 10	8 12	PSM database
Selenastrum carpicornutum	biomass	7 d	EC 50	10 38	PSM database
Selenastrum carpicornutum	biomass	7 d	EC 10	4.58	PSM database
Selenastrum carpicornutum	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
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Cochlea

Semisulcospira libertina	mortality	2 d	LC 50	8000	Hashimoto & Nishiuchi 1981
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5. Bibliography

BBA, 1998

Liste der Wirkstoffe in zugelassenen Pflanzenschutzmitteln.

www.bba.de, Phytomed-Datenbank

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

Bulcke, R.A.J., Stryckers, J.M.T., 1977

Bioassays for the detection of herbicides and algicides in water.

Meded Fac Landbouwwet Rijksuniv Gent, 42 (2pt2), 1625-1634; cited in Shuker and Hutton (1986)

Caldwell, R.S., 1977

Biological effects of pesticides on the Dungeness crab.

US Department of Commerce, NTIS No. PB-276 978

Caldwell, R.S., Buchanan, D.V., Armstrong, D.A., Mallon, M.H., Millemann, R.E., 1979

Toxicity of the herbicides 2,4-D, DEF, Propanil and Trifluralin to the Dungeness crab, Cancer magister.

Arch. Environ. Contam. Toxicol. 8 (4), 383-396

Cope, O.B., 1965

Sport Fishery Investigations.

In: U.S. Fish Wildl. Serv. Circ. 226, 51-63

Couch, J.A., Winstead, J.T., Hansen, D.J., Goodman, L.R., 1979

Vertebral dysplasia in young fish exposed to the herbicide trifluralin.

Journal of Fish Diseases, 2, 35-42

Hashimoto, Y., Nishiuchi, Y., 1981

Establishment of bioassay methods for the evaluation of acute toxicity of pesticides to aquatic organisms.

J. Pest. Sci. 6 (2) 257-264 (JPN with ENG Summary)

- Huckins, J.N., Petty, J.D., England, D.C. 1986
Distribution and impact of trifluralin, atrazine and fonofos residues in microcosms simulating a northern prairie wetland.
Chemosphere 15 (5), 563-588
- Johnson, B.T., 1986
Potential impact of selected agricultural chemical contaminants on a northern prairie wetland: A microcosm evaluation.
Environ. Toxicol. Chem. 5, 473-485
- Johnson W.W., Finley, M.T., 1980
Handbook of acute toxicity of chemicals to fish and aquatic invertebrates.
Resource Publication 137, Fish and Wildlife Service, U.S.D.I., Washington, D.C.
- Liu, D.H.W., Lee, J.M., 1975
Toxicity of selected pesticides to the bay mussel (*Mytilus edulis*).
Ecol. Res. Serv., EPA-660/3-75-016, Natl. Environ. Res. Center, U.S. EPA, Corvallis, OR; U.S. NTIS, PB-243, 221, 102 p.
- Macek, K.J., Hutchinson, C., Cope, O.B., 1969
The effects of temperature on the susceptibility of bluegills and rainbow trout to selected pesticides.
Bull. Environ. Contam. Toxicol. 4 (3) 174-183
- Macek, K.J., Lindberg, M.A., Sauter, S., Buxton, K.S., Costa, P.A., 1976
Toxicity of four pesticides to water fleas and fathead minnows.
Ecological Research Series, EPA-600/3-76-099, Environ. Res. Lab., U.S. Environ. Prot. Agency, Duluth, MN, 68 p.
- Mc Corkle, F.M., Chambers, J.E., Yarbrough, J.D., 1977
Acute Toxicities of selected herbicides to fingerling channel catfish, *Ictalurus punctatus*.
Bull. Environ. Contam. Toxicol. 18, 267-270
- Naqvi, S.M., Davis, V.O., Hawkins, R.M., 1985
Percent mortalities and LC 50 values for selected microcrustaceans exposed to Treflan, Cutrine-Plus, and MSMA herbicides.
Bull. Environ. Contam. Toxicol. 35 (1), 127-132
- Naqvi, S.M., Leung, T.S., 1983
Trifluralin and Oryzalin herbicides toxicities to juvenile crawfish (*Procambarus clarkii*) and mosquitofish (*Gambusia affinis*).
Bull. Environ. Contam. Toxicol. 31 (3) 304-308
- Nimmo, D.R., Hamaker, T.L. et al., 1981
An overview of the acute and chronic effects of first and second generation pesticides on an estuarine mysid.
In: Biological Monitoring of Marine Pollutants Edited by Vernberg, J., Calabrese, A. et al.

Parka, S.J., Worth, H.M., 1965

The effects of trifluralin to fish.

Proceedings of the Southern Weed Conference, 18th Meeting, 469

Parrish, P.R. et al., 1978

Chronic toxicity of chlordane, trifluralin and pentachlorophenol to sheepshead minnows (*Cyprinodon variegatus*).

US EPA Office of Research and Development, EPA-600/3-78-010

PSM-Datenbank (PSM database),

Umweltbundesamt (Federal Environmental Agency), Berlin

Reinbold, K.A., 1974

Effects of the synergist piperonyl butoxide on toxicity and metabolism of pesticides in green sunfish (*Lepomis cyanellus rafinesque*).

Ph.D. Thesis, University of Illinois, Urbana-Champaign, IL: 79 p., Dissert. Abstr. Int. B 35 (11) 5254

Sanders, H.O., 1970

Toxicities of some herbicides to six species of freshwater crustaceans.

J. Water Pollut. Control Fed. 24 (8), 1544-1550

Sanders, H.O., Cope, O.B., 1966

Toxicities of several pesticides to two species of cladocerans.

Trans. Am. Fish. Soc. 95, 165-169

UNEP/IRPTC

International Register of Potentially Toxic Chemicals - COPYRIGHT 1990 UNEP-

United Nations Environment Programme / International Register of Potentially Toxic, Palais des Nations, CH-1211 Genf 10

Walsh, G.E., 1972

Effects of herbicides on photosynthesis and growth of marine unicellular algae.

Hyacinth Control J. 10, 45-48, author communication used

Yockim, R.S. et al., 1980

Behaviour of trifluralin in aquatic model ecosystems.

Bull. Environ. Contam. Toxicol. 24, 134-141

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 *Buccinum undatum* was $< 0.0083 \mu\text{g/l}$. The NOEC values of the most sensitive shell species were recorded around $< 0.005 \mu\text{g/l}$.

The quality target for aquatic communities was derived by multiplying the effective threshold value for development inhibition of the crab *Acartia tonsa* ($0.001 \mu\text{g/l}$ TBT) by the compensation factor $F1 = 0.1$. Therefore, the quality target for aquatic communities is $0.0001 \mu\text{g/l}$ TBT. The quality target refers to the TBT cation.

3. Drinking Water Supply

The maximum value of $0.1 \mu\text{g/l}$ determined in EC Directive 80/778/EEC is adopted to protect the drinking water supply. The quality target is $0.1 \mu\text{g/l}$.

4. Test Results

Species	Effect	Time	Value	Conc. [$\mu\text{g/l}$]	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 latipes	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	30000 0	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
Oryzias latipes	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
<i>Daphnia longispina</i>	mortality	72 h	LC100	60	Floch et al. 1964
<i>Daphnia magna</i>	immobilization	24 h	EC50	14	Vighi & Calamari 1985
<i>Daphnia magna</i>	immobilization	24 h	EC50	36	Steinhäuser et al. 1985
<i>Daphnia magna</i>	immobilization	2 d	EC50	0.750	Mathijssen-Spiekman et al. 1989
<i>Daphnia magna</i>	mortality	48 h	LC50	1.670	UK Department of the Environment 1986
<i>Daphnia magna</i>	mortality	48 h	LC50	3	Polster & Halacka 1971
<i>Daphnia magna</i>	mortality	20 d	LC50	1.8	Mathijssen-Spiekman et al. 1989
<i>Daphnia magna</i>	immobilization	1 d	EC50	30	Kühn et al. 1989
<i>Daphnia magna</i>	reproduction	21 d	NOEC	0.160	Kühn et al. 1989
<i>Daphnia magna</i>	reproduction	21 d	NOEC	0.2	Analyt. Bio-Chemistry Laboratories Inc. 1990
<i>Daphnia magna</i>	reproduction	21 d	LOEC	0.4	Analyt. Bio-Chemistry Laboratories Inc. 1990
<i>Daphnia magna</i>	reproduction	20 d	EC50	2.1	Mathijssen-Spiekman et al. 1989
<i>Hemigrapsus nudus</i>	mortality	14 d	TC	25	Laughlin & French 1980
<i>Homarus americanus</i>	mortality	6 d	TC100	5	Laughlin & French 1980
<i>Homarus americanus</i>	mortality	24 d	TC100	20	Laughlin & French 1980
<i>Homarus americanus</i>	mortality	24 d	TC	1	Laughlin & French 1980
<i>Nitocra spinipes</i>	mortality	96 h	LC50	2	Linden et al. 1979
<i>Palaemonetes pugio</i>	mortality	4 d	LC50	20	Clark et al. 1987
<i>Palaemonetes pugio</i>	moulting	21 d	NOEC	0.1	Khan et al. 1993
<i>Palaemonetes pugio</i>	mortality, larvae	4 d	LC50	4.1	Khan et al. 1993
<i>Penaeus duorarum</i>	mortality	1 d	LC50	15	Heitmuller 1977
<i>Penaeus duorarum</i>	mortality	2 d	LC50	13	Heitmuller 1977
<i>Penaeus duorarum</i>	mortality	4 d	LC50	11	Heitmuller 1977
<i>Rhithropanopeus harrisii</i>	mortality	10 d	LC50	0.35	Laughlin et al. 1984
<i>Uca pugnator</i>	regeneration	7 d	TC	0.5	Weis & Kim 1988
Fish					
<i>Alburnus alburnus</i>	mortality	96 h	LC50	15	Linden et al. 1979
<i>Carassius auratus</i>	mortality	24 h	LC100	75	Deschiens et al. 1968
<i>Cyprinodon variegatus</i>	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
<i>Rana temporaria</i>	mortality	4 d	LC50	1 650	Hooftman et al. 1989
Insects					
<i>Aedes aegypti</i>	mortality	1 d	LC50	17	Das et al. 1984
<i>Aeschna</i> sp.	mortality	48 h	LC100	250	Deschiens et al. 1968
<i>Chironomus riparius</i>	mortality	4 d	LC50	3 360	Hooftman et al. 1989
<i>Chironomus plumosus</i>	mortality	4 d	LC50	0.05	Fargasova 1998
<i>Culex pipiens</i>	mortality	24 h	LC50	0 380	Gras et al. 1965
<i>Notonectes</i> sp.	mortality	72 h	LC100	60	Floch et al. 1964
Shells					
<i>Anodonta cygnea</i>	growth	8 d	TC	0.2	Machado et al. 1989
<i>Corbicula fluminea</i>	mortality	24 h	LC50	2100	Foster 1981
<i>Crassostrea gigas</i>	respiration	14 d	TC	0.020	Lawler & Aldrich 1987
<i>Crassostrea gigas</i>	growth	48 d	NOEC	0.010	Lawler & Aldrich 1987
<i>Crassostrea gigas</i>	growth, effect 58%	28 d	TC	0.005	Nell & Chvojka 1992
<i>Crassostrea gigas</i>	growth	28 d	NOEC <	0.005	Nell & Chvojka 1992
<i>Crassostrea gigas</i>	growth, effect 38%	56 d	TC	0.15	Waldock & Thain 1983
<i>Crassostrea virginica</i>	mortality	90 d	TC	0.050	Pickwell & Steinert 1988
<i>Crassostrea virginica</i>	onogenesis	2 d	EC50	0.9	Hollister 1977
<i>Mercenaria mercenaria</i>	mortality	2 d	LC50	1	Laughlin et al. 1989
<i>Mercenaria mercenaria</i>	growth	14 d	TC	0.010	Laughlin et al. 1988
<i>Mercenaria mercenaria</i>	growth	14 d	NOEC <	0.0048	Laughlin et al. 1988
<i>Mercenaria mercenaria</i>	growth NOEC = LOEC / 2 (geom. measured)	14 d	NOEC	0.0024	Laughlin et al. 1988
<i>Mytilopsis sallei</i>	mortality	4 d	LC50	53	Karande et al. 1993
<i>Mytilus edulis</i>	cytogenetic effect	1 d	TC	0.050	Dixon & Prosser 1986
<i>Mytilus edulis</i>	mortality	10 d	TC100	0.2	Beaumont & Budd 1984
<i>Mytilus edulis</i>	mortality	4 d	TC	0.050	Dixon & Prosser 1986
<i>Mytilus edulis</i>	mortality	15 d	TC	0.020	Beaumont & Budd 1984
<i>Mytilus edulis</i>	mortality	90 d	TG	0.050	Pickwell & Steinert 1988
<i>Mytilus edulis</i>	growth	7 d	NOEC	0.1	Stromgren & Bongard 1987

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

5. Bibliography

ACIMA AG, 1985

Testprotokoll zur akuten Bakterientoxizität von Tributylzinnoxid gegenüber *Pseudomonas putida*.

ACIMA AG, CH- 9470 Buchs. Im Auftrag der ORTEP Association

Analyt. Bio-Chemistry Laboratories Inc., 1990 a

Zitiert in einem Schreiben der Firma Schering vom 28.8.1991 and das Umweltbundesamt, Berlin

BBA, 1998

Liste der Wirkstoffe in zugelassenen Pflanzenschutzmitteln

www.bba.de, Phytomed-Datenbank

Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig

Beaumont, A.R., Budd, M.D., 1984

High Mortality of the Larvae of the Common Mussel at Low Concentrations of Tributyltin.
Mar. Pollut. Bull. 15(11):402-405

Beaumont, A.R., Newman, P.B., 1986

Low Levels of Tributyl Tin Reduce Growth of Marine Micro-Algae.

Mar. Pollut. Bull. 17(10):457-461

Buccafusco, R. 1976

Acute Toxicity of Tri-N-Butyltin oxide to Channel Catfish (*Ictalurus punctatus*), the Fresh Water Clam (*Elliptio complanatus*), the Common Mummichog...

U.S. EPA-OPP Registration Standard

Bushong, S.J., Ziegenfuss, M.C., Unger, M.A., Hall Jr., L.W., 1990

Chronic Tributyltin toxicity experiments with the Chesapeake Bay copepod, *Acartia tonsa*
Environmental Toxicology and Chemistry, 9, 359-366

Cardarelli, N.F., 1973

Development and testing of molluscicidal and cercariadal formulation.

Annual Report 1972 of Creative Biology Laboratory to World Health Organisation, Norton, Ohio

Cardwell, R.D., Sheldon, A.W., 1986

A risk assessment concerning the fate and effects of tributyltins in the aquatic environment.
Oceans, 86, (4), 1117-1129 (zitiert in Crommentuijn et al. 1997)

Clark, J.R., Patrick, Jr., J.M., Moore, J.C., Lores, E.M., 1987

Waterborne and Sediment-Source Toxicities of Six Organic Chemicals to Grass Shrimp (*Palaemonetes pugio*) and Amphioxus (*Branchiostoma caribaeum*).

Arch. Environ. Contam. Toxicol. 16:401-407

Cramm, G. 1979

Acute and Chronic Toxicity of Tributyltin oxide (TBTO) to Sheepshead Minnows (*Cyprinodon variegatus*).

U.S. EPA-OPP Registration Standard

Crisinel, A. et al., 1994

Cyst-based ecotoxicological tests using anostraceas: Comparison of two species of *Streptocephalus*.

Environ. Toxicol. Water Qual., 9, (4), 317-326

Crommentuijn, T., Kalf, D.F., Polder, M.D., Posthumus, R., Plassche, E.J. van de , 1997

Maximum Permissible Concentrations and Negligible Concentrations for Pesticides

Rijksinstituut voor Volksgezondheid en Milieuhygiene, RIVM Report 601501002,

Bilthoven/NL

Das, V.G.K., Kuan, L.Y., Sudderuddin, K.I., Chang, C.K., Thomas, V. et al., 1984

The Toxic Effects of Triorganotin (IV) Compounds on the Culicine Mosquito, *Aedes aegypti* (L).

Toxicology 32(1):57-66

Davies, I.M., McKie, J.C., 1987

Accumulation of Total Tin and Tributyltin in Muscle Tissue of Farmed Atlantic Salmon.

Mar. Pollut. Bull. 18(7):405-407

Deschiens, R. et al., 1966

Controle sur le terrain des proprietes molluscicides de l'oxyde de tributyl-etain (prophylaxie des bilharzioses).

Bull. Soc. Pathol. Exotique 59, 231-234

Deschiens, R. et al., 1968

Action biologique comparee de 6 molluscicides chimiques dans le cadre de la prophylaxie des bilharzioses. Conclusions pratiques.

Bull. Soc. Pathol. Exotique 61, 640-650

Deschiens, R.H. et al., 1966

Application sur le terrain, au cameroun, dans la prophylaxie des bilharzioses de l'action molluscicide de l'oxyde de tributyletain.

Bull. Soc. Pathol. Exotique 59, 968-973

Dixon, D.R., Prosser, H., 1986

An Investigation of the Genotoxic Effects of an Organotin Antifouling

Compound(Bis(Tributyltin) oxide) on the Chromosomes of the Edible Mussel,

Aquat. Toxicol. 8(3):185-195

Fargosova, A., 1998

Comparison of tributyltin compound effects on the alga *Scenedesmus quadricauda* and the benthic organisms *Tubifex tubifex* and *Chironomus plumosus*

Ecotoxicol. Environ. Saf. 41, 222-230

Fent, K., Meier, W., 1992

Tributyltin-induced effects on the early life stages of minnows *Phoxinus phoxinus*.

Arch. Environ. Contam. Toxicol., 22, 428-438 (zitiert in Crommentuijn et al., 1997)

Floch, H. et al., 1964

Sur les proprietes molluscicides de l'oxyde de l'acetate de tributyl-etain (prophylaxie des bilharzioses)

Bull. Soc. Pathol. Exotique 57 (3), 454-465

Foster, R.B., 1981

Use of asiatic clam larvae in aquatic hazard evaluations.

In: Ecological assessments of effluent impacts on communities of indigenous aquatic organisms. Eds.: J.M. Bates and C.J. Weber, ASTM STP 730, American Soc. for Testing and Materials, Philadelphia, 280-288

Geiger, D.L., Brooke, L.T., Call, D.J., 1990

Acute Toxicities of Organic Chemicals to Fathead Minnows (*Pimephales promelas*), Vol. 5. Center for Lake Superior Environmental Studies, University of Wisconsin, Superior, WI:332 p.

Gras, G. et al., 1965

Relation entre la structure chimique et l'activité insecticide des composés organiques de l'étain (essai sur les larves de *Culex pipiens pipiens L.*)
Arch. Inst. Pasteur Tunis 42, 9-22

Hall, L.W. et al., 1985

Acute and sublethal effects of organotin compounds on aquatic biota: an interpretative literature evaluation.

Critical Reviews in Toxicology 14, 159-205

Hall, L.W. et al., 1988

Acute and chronic effects of tributyltin on a Chesapeake Bay copepod.
Environ. Toxicol. Chem., 7, 41-46 (zitiert in Crommentuijn et al., 1997)

Hallas, L.E. et al., 1981

Effects of stannic chloride and organotin compounds on estuarine microorganisms.
Dev. Ind. Microbiology 22, 529-535

Heitmüller, T., 1977

Toxicity of Tri-N-Butyltin oxide (TBTO) to Pink Shrimp (*Penaeus duorarum*).
USEPA-OPP Registration Standard

Hollister, T., 1977

Toxicity of Tri-N-Butyltin oxide (TBTO) to Embryos of Eastern Oysters (*Crassostrea virginica*).
USEPA-OPP Registration Standard

Holm, G., Norrgren, L., Linden, O., 1991

Reproductive and Histopathological Effects of Long-Term Experimental Exposure to bis(Tributyltin)oxide (TBTO) on the Three-Spined Stickleback....
J. Fish. Biol. 38(3):373-386

Hoofman, R.N., Adema, D.M.M., Kauffman-Van Bommel, J., 1989

Developing a Set of Test Methods for the Toxicological Analysis of the Pollution Degree of Waterbottoms.

Netherlands Organization for Applied Scientific Research, Report No. 16105:68 p. (DUT)

Hopf, H.S. et al., 1966

The molluscicidal properties of organotin and organolead compounds.
Bilharziosis Research Mol./Inf./66.21 (WHO), VII 1- VII 5

- Hopf, H.S. et al., 1967
Molluscicidal properties of organotin and organolead compounds.
Bull. WHO 36, 955-961
- Jak, R.G., Ceulemans, M., Scholten, M.C.Th., van Straalen, N.M., 1998
Effects of tributyltin on a coastal North Sea plankton community in enclosures.
Environmental Toxicology and Chemistry, 17, 1840-1847
- Karande et al., 1993
Toxicity of tributyltin to some bivalve species.
Indian. Journal of Mar. Sci., 22, 153-154 (zitiert in Crommentuijn et al., 1997)
- Khan, A.T., Weis, J.S., Saharig, C.E., Polo, A.E., 1993
Effect of Tributyltin on Mortality and Telson Regeneration of Grass Shrimp, *Palaemonetes pugio*.
Bull. Environ. Contam. Toxicol, 50(1): 152-157
- Kühn, R. et al., 1988
Schadstoffwirkungen von Umweltchemikalien im Daphnien- Reproduktions-Test als Grundlage für die Bewertung der Umweltgefährlichkeit in aquatischen Systemen.
Umweltbundesamt, Berlin, Forschungsbericht 10603052
- Kühn, R. et al., 1989
Results of the Harmful Effects of Water Pollutants to *Daphnia magna* in the 21 Day Reproduction Test.
Water Research, 23 (4), 1989, S. 501-510
- Kühn, R., Pattard, M., 1990
Results of the harmful effects of water pollutants to green algae (*Scenedesmus subspicatus*) in the cell multiplication inhibition test.
Water. Res., 24 (1), 31-38
- Kusk, K.O., Petersen, S., 1997
Acute and chronic toxicity of tributyltin and linear alkylbenzene sulfonate to the marine copepod *Acartia tonsa*
Environmental Toxicology and Chemistry, 16, 1629-1633
- Lapota et al., 1993 Growth and survival of *Mytilus edulis* larvae exposed to low levels of dibutyltin and tributyltin
Marine Biology, 115, 413-419 (zitiert in Crommentuijn et al., 1997)
- Laughlin, R. et al., 1984
Long term effects of tributyltin compounds on the Baltic amphipod, *Gammarus oceanicus*.
Mar. Environ. Res., 12, 243-271 (zitiert in Crommentuijn et al., 1997)
- Laughlin, R., Linden, O., 1982
Sublethal responses of the tadpoles of the european frog *Rana temporaria* to two tributyltin compounds
Bull. Environm. Contam. Toxicol. 28 (4), 494-499
- Laughlin, R.B.Jr., French, W.J., 1980
Comparative Study of the Acute Toxicity of a Homologous Series of Trialkyltins to Larval Shore Crabs *Hemigrapsus nudus*, and Lobster, *Homarus americanus*.
Bull. Environ. Contam. Toxicol. 25(5):802-809

- Laughlin, R.B.Jr., French, W.J., Johannesen, R.B., Guard, H.E., Brinckman, F.E., 1984
Predicting Toxicity Using Computed Molecular Topologies: The Example of Triorganotin Compounds. *Chemosphere* 13(4):575-584
- Laughlin, R.B.Jr., Gustafson, R.G., Pendoley, P. 1988
Chronic Embryo-Larval Toxicity of Tributyltin (TBT) to the Hard Shell Clam *Mercenaria mercenaria*.
Mar. Ecol. Prog. Ser. 48(1):29-36
- Laughlin, R.B.Jr., Gustafson, R.G., Pendoley, P. 1989
Acute Toxicity of Tributyltin (TBT) to Early Life History Stages of the Hard Shell Clam, *Mercenaria mercenaria*.
Bull. Environ. Contam. Toxicol. 42(3):352-358
- Lawler, I.F., Aldrich, J.C., 1987
Sublethal Effects of Bis(Tri-n-Butyltin)Oxide on *Crassostrea gigas* Spat.
Mar. Pollut. Bull. 18(6):274-278
- Linden, E., Bengtsson, B.E., Svanberg, O., Sundstrom, G. 1979
The acute toxicity of 78 chemicals and pesticide formulations against two brackish water organisms, the bleak (*Alburnus alburnus*) and the harpacticoid (*Nitocra spinipes*).
Chemosphere, 8 (11/12), 1979, 843-851 (AQUIRE: Author Communication Used)
- Machado, J., Coimbra, J., Sa, C., 1989
Shell Thickening in *Anodonta cygnea* by TBTO Treatments.
Comp. Biochem. Physiol. 92C(1):77-80
- Martin, R.C., Dixon, D.G., Maguire, R.J., Hodson, P.V., Tkacz, R.J., 1989
Acute Toxicity, Uptake, Depuration and Tissue Distribution of Tri-n-Butyltin in Rainbow Trout, *Salmo gairdneri*.
Aquat. Toxicol. 15(1):37-52
- Maruyama, T., Sun, D., Hashimoto, S., Miura A., 1991
Toxic Effects of Triorganotins on the Adhesion and Germination - Growth of Conchospores of *Porphyra yezoensis*, Red Alga
Mar. Pollut. Bull. 23:729-731
- Mathijssen-Spiekman, E.A.M., Canton, J.H., Roghair, C.J., 1989
Research After the Toxicity of TBTO for a Number of Fresh Water Organisms. National Institute of Public Health and Environmental Hygiene, Report No. 668118-001:48 p. (DUT)
- Matthiessen, P., Gibbs, P.E., 1998
Critical appraisal of the evidence for tributyltin-mediated endocrine disruption in molluscs
Environ. Toxicol. Chem., 17, 37-34
- Meador, J.P., 1986
An analysis of photobehaviour of *Daphnia magna* exposed to tributyltin.
In: Oceans'86 Conference, Washington D.C., USA Sept. 23-25 1986, Vol 4, "Proceedings of the organotin symposium" 1213-1218
- Meador, J.P., 1997
Comparative toxicokinetics of tributyltin in five marine species and its utility in predicting bioaccumulation and acute toxicity.
Aquat. Toxicol. 37, 307-326

Mensink et al., 1996

The development of imposex in relation to organotin contamination in the common whelk, *Buccinum undatum*.

Nederlands Instituut voor Onderzoek der Zee, NIOZ-rapport 1996-3

Miana et al., 1993

Sensitivity of *Selenastrum capricornutum*, *Daphnia magna* and submitochondrial particles tributyltin.

Environmental Technology, 14, 175-181 (zitiert in Crommentuijn et al., 1997)

Moore et al., 1991

Chronic toxicity of tributyltin to the marine polychaeta worm, *Neanthus arenaeodentata*.

Aquatic Toxicology, 21, 181-198 (zitiert in Crommentuijn et al., 1997)

Nagase et al., 1991

Structure-activity relationships for organotin compounds on the red killifish *Oryzias latipes*.

Applied organometallic Chemistry, 5, 91-97 (zitiert in Crommentuijn et al., 1997)

Nell, J.A., Chvojka, R., 1992

The effect of bis-tributyltin oxide (TBTO) and copper on the growth of juvenile Sydney rock oysters *Saccostrea commercialis* (Iredale and Roughley) and pacific oysters *Crassostrea gigas* Thunberg.

Sci. Total Environ. 125, 192-201

Nishiuchi, Y., Yoshida, K., 1972

Toxicities of Pesticides to Some Fresh Water Snails.

Bull. Agric. Chem. Insp. Stn. (12):86-92 (JPN) (ENG ABS) (Author Communication Used)

Oehlmann, J., Stroben, E., Schulte-Oehlmann, Bauer, B., 1998

Imposex development in response to TBT pollution in *Hinia incrassata* (Ström, 1768) (Prosobranchia, Stenoglossa)

Aquatic Toxicology 43, 239-260

Pereira De Souza, C. Paulini, E., 1970

Absorption of Molluscicides by Calcium Carbonate.

Rev. Bras. Malariol. Doencas Trop. 21(4):799-818 (POR) (ENG ABS)

Pickwell, G.V. Steinert, S.A., 1988

Uptake and Accumulation of Organotin Compounds by Oyster and Mussel Hemocytes: Correlation with Serum Biochemical and Cytological Factors and

Aquat. Toxicol. 11(3-4):419-420 (ABS)

Pinkey, A.E. et al., 1985

Comparison of avoidance responses of an estuarine fish, *Fundulus heteroclitus*, and crustacean, *Palaemonetes pugio*, to bis(tri-n-butyltin)oxide.

Water Air and Soil Pollution 25,33-40

Plum, H., 1981

Comportement des composés organo-stanniques Vis-a-vis de l'environnement.

Informations Chimie 220, 135-139

- Polster, M., Halacka, K., 1971
Beitrag zur hygienisch-toxikologischen Problematik einiger antimikrobiell gebrauchter Organozinnverbindungen.
Ernährungsforschung XVI (4), 527-535
- Ritchie, L.S. et al., 1964
Molluscidal time-concentration-relationships of organotin compounds.
Bull. WHO 31 (1), 147-149
- Ritchie, L.S. et al., 1974
Prolonged applications of an organotin against *Biomphalaria glabrata* and *Schistosoma mansoni*.
In: Molluscicides in schistosomiasis control, N.Y., 77-88
- Ruiz et al., 1995
Effects of Tributyltin (TBT) exposure on the reproduction and embryonic development of the bivalve *Scrobicularia plana*.
Mar. Environ. Res., 40, (4), 363-379 (zitiert in Crommentuijn et al., 1997)
- Schwaiger, J.; Schilling, N.; Braun, F.; Kalbfus, W.; Hoffmann, R.W.; Negele, R.D., 1992
Untersuchungen über die ökotoxikologischen Langzeitwirkungen von Chemikalien auf aquatische Organismen.
Umweltbundesamt, Berlin, Forschungsbericht: 116 08 07/02
- Seinen, W. et al., 1981
Short term toxicity of tri-n-butyltin chloride in rainbow trout (*Salmo gairdneri* Richardson) yolk sac fry.
The Science of the Total Environment 19, 155-166
- Short, J.W., Thrower, F.P., 1987
Toxicity of Tri-N-Butyl-Tin to Chinook Salmon, *Oncorhynchus tshawytscha*, Adapted to Seawater.
Aquaculture 61(3-4):193-200
- Steinhäuser, K.G. et al., 1985
Untersuchungen zur aquatischen Toxizität zinnorganischer Verbindungen.
Vom Wasser, 65, 203-214
- Stickle et al., 1990
Imposex induction in *Nucella lima* (Gmelin) via mode of exposure to tributyltin.
J. Exp. Mar. Biol. Ecol., 143, 165-180 (zitiert in Crommentuijn et al., 1997)
- Stroemgren, T., Bongard, T., 1987
The Effect of Tributyltin Oxide on Growth of *Mytilus edulis*.
Mar. Pollut. Bull. 18(1):30-31
- Stroganov, N.S., Khobot'Ev, V.G., Kolosova, L.V., 1972
Study of the Connection of the Chemical Composition of Organometallic Compounds with their Toxicity for Hydrobionts.
Transl. Mono. Vopr. Vodn. Toksikol. Moscow: 66-74 (1970), U.S. NTIS PB-208 082-T;
Govt. Repts. Announc. Index 7210:10 p.

- Stromgren, T. Bongard, T., 1987
The Effect of Tributyltin Oxide on Growth of *Mytilus edulis*.
Mar. Pollut. Bull. 18(1):30-31 (quoted in Crommentuijn et al. 1997)
- U'Ren, S.C. 1983
Acute Toxicity of Bis(Tributyltin) oxide to a Marine Copepod.
Mar. Pollut. Bull. 14(8):303-306
- UK Department of the Environment, 1986
Organotin in antifouling paints, environmental considerations.
Central Directorate of Environmental Protection, Pollution Paper No. 25
- Van der Kerk, G.J.M et al., 1962
Fortschritte auf dem Organozinngebiet
Chimia 16, 36-42
- Vighi, M., Calamari, D., 1985
QSARs for organotin compounds on *Daphnia magna*.
Chemosphere 14 (11/12), 1925-1932
- Vries, H. de et al., 1990
Comparative toxicity of some organotin compounds in rainbow trout (*Oncorhynchus mykiss*)
yolk sac fry.
Department of veterinary, pharmacol., pharmac. and toxicol. University of Utrecht, Post box
80.176, Yalelaan 2, NL-3508 TD Utrecht, The Netherlands
- Waldock, M.J., Thain, J.E., 1983
Shell Thickening in *Crassostrea gigas*: Organotin Antifouling or Sediment Induced?
Mar. Pollut. Bull. 114(11):411-415
- Walsh, G.E., McLaughlan, L.L., Lores, E.M., Louie, M.K., Deans, C.H., 1985
Effects of Organotins on Growth and Survival of Two Marine Diatoms, *Skeletonema*
costatum and *Thalassiosira pseudonana*.
Chemosphere 14(3-4):383-392
- Walsh, G.E., McLaughlin, L.L., Louie, M.K., Deans, C.H., Lores, E.M., 1986
Inhibition of ARM Regeneration by Ophioderma brevispina (Echinodermata, Ophiuroidea)
by Tributyltin oxide and Triphenyltin oxide.
Ecotoxicol. Environ. Chem. 12(1):95-100
- Ward, G., 1984
Chronic Toxicity of Tributyltin Flouride to the Pacific Oyster (*Crassostrea gigas* Thunberg).
U.S. EPA-OPP Registration Standard
- Webbe, G. et al., 1964
Laboratory tests of some new molluscicides in Tanganyika
Annals of tropical medicine and parasitology 58, 234-239
- Weis, J.S. Kim, K., 1988
Tributyltin is a Teratogen in Producing Deformities in Limbs of the Fiddler Crab, *Uca*
pugilator.
Arch. Environ. Contam. Toxicol. 17(5):583-587

Wester, P.W. Canton J.H., 1987

Histopathological Study of *Poecilia reticulata* (Guppy) After Long-Term Exposure to Bis(Tri-n-Butyltin)oxide (TBTO) and Di-n-Butyltindichloride.

Aquat. Toxicol. 10(2-3):143-165

Wester, P.W., Canton, J.H., 1987

Histopathological study of *Poecilia reticulata* (guppy) after long-term exposure to bis (tri-n-butyltin)oxide (TBTO) and di-n-butyltinchloride (DBTC).

Aquatic Toxicology, 10, 143-165

Wester, P.W., Canton, J.H., Van Iersel, A.A.J., Krajnc, E.I., Vaessen, H.A.M.G., 1990

The toxicity of bis (tri-n-butyltin) oxide (TBTO) and di-n-butyltindichloride (DBTC) in small fish species *Oryzias latipes* (medaka) and *Poecilia reticulata* (guppy).

Aquatic Toxicology 16, 53-72

Wong, P.T.S., ,Chau, Y.K., Kramar, O., Bengert, G.A., 1982

Structure-Toxicity Relationship of Tin Compounds on Algae.

Can. J. Fish. Aquat. Sci. 39(3):483-488

Zabel, T.F. et al., 1988

Proposed environmental quality standards for list II substances in water. Organotins.

Water Research Center, Environmental Strategy, Standards and Legislation Unit TR 255

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 $F2 = 0.1$.

($QT = 0.045 \times 0.1 \times 0.1 = 0.00045$ 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
<i>Pimephales promelas</i>	mortality	30 d	LC50	1.4	Jarvinen et al 1988
<i>Pimephales promelas</i>	growth	4 d	EC50	3.5	Jarvinen et al 1988
<i>Pimephales promelas</i>	mortality	4 d	LC50	6.8	Jarvinen et al 1988
Shells					
<i>Crassostrea virginica</i>	no data	4 d	EC50	0.31	U.S. EPA 1995

5. Bibliography

- Cotta-Ramusino, M., Doci, Antonella, 1987
Acute Toxicity of Brestan and Fentin Acetate on Some Freshwater Organisms.
Bull. Environ. Contam. Toxicol. 38: 647-652
- Frick, I.P., de Jeminez, W.Q., 1964
Molluscicidal Qualities of Three Organo-tin Compounds Revealed by 6-hours and 24-hour Exposures against Representative Stages and Sizes of *Australorbis glabratus*.
Bulletin of the World Health Organization 31: 429-431
- Goel, H.C., Prasad, R., 1978
Action of Molluscicides on Freshly Laid Eggs of the Snail *Indoplanorbis exustus* (Deshayes).
Indian J. Exp. Biol. 16, 620-622
- Jarvinen, A.W., Tanner, D.K., Kline, E.R., Knuth, M.L., 1988
Acute and Chronic Toxicity of Triphenyltin Hydroxide to Minnows (*Pimephales promelas*) Following Brief or Continuous Exposure.
Environmental Pollution 52, 289-301
- Liyang, Z., Xiankun, L., Bingyn, S., 1990
Toxic Effects of Organotin on Marine Diatoms.
Journal of Ocean University of Qingdao 20 (4), 125-131
- Maruyama, T. Sun, D., Hashimoto, S., Miura, A., 1991
Toxic effects of Triorganotins on the adhesion and germination - growth of conchospores of *Porphyra yezoensis*, red alga.
Marine Pollution Bulletin, Vol. 23 pp 729-731
- Seiffer, E.A., Schoof, H.F., 1967
Tests of 15 Experimental Molluscicides against *Australorbis glabratus*.
Public health report 82 (9), 833-839
- Steinhäuser, K.G., Amann, W., Späth, A., Polenz, A., 1985
Untersuchungen zur aquatischen Toxizität zinnorganischer Verbindungen.
Vom Wasser 65, 203-214

U.S. EPA, Office of Pesticide Programs, 1995

Environmental Effects Database (EEDB).

Environmental Fate and Effects Division, U.S. EPA, Washington, D.C.

Vries, H. de., Penninks, A.H., Snoeij, N.J., Seinen, W., 1991

Comparative toxicity of organotin compounds to rainbow trout (*Oncorhynchus mykiss*) yolk sac fry.

The Science of the Total Environment 103, 229-243

Walsh, G.E., Mc Laughlan, L.L., Lores, E.M., Louie, M.K., Deans, C.H., 1985

Effects of Organotin on Growth and Survival of two Marine Diatoms, *Skeletonema costatum* and *Thalassiosira pseudonana*.

Chemosphere, Vol. 14 (3/4), 383-392

Webe, G., Sturrock, R.F., 1964

Laboratory Tests of some New Molluscicides in Tanganyika.

Annals of Tropical Medicine and Parasitology 58, 234-239

Wong, P.T.S., Chau, Y.K., Kramar, O., Bengert, G.A., 1982

Structure-toxicity Relationship of Tin Compounds on Algae.

Can. J. Fish. Aquat. Sci. 39, 483-488

Yatome, C., Yamauchi, Y., Ogawa, T., 1993

Effects of Organotin Compounds on the Synthesis of Nucleic Acids and ATP in the Growth Process of *Bacillus subtilis*.

Bull. Environ. Contam. Toxicol. 51, 234-240