

Supplementary material

This supplement contains:

- **Table S1:** Toxicity of Glyphosate and AMPA to aquatic microorganisms.
- **Table S2:** Toxicity of Glyphosate and AMPA to aquatic invertebrates.
- **Table S3:** Toxicity of Glyphosate and AMPA to fish.
- **Table S4:** Toxicity of Glyphosate and AMPA to amphibians.
- **Table S5:** Toxicity of Glyphosate and AMPA to aquatic macrophytes.
- **Table S6:** Toxicity of Glyphosate to benthic organisms.
- **References of supplementary material.**

Table S1: Toxicity of Glyphosate and AMPA to aquatic microorganisms.

AQUATIC MICROORGANISMS									
Glyphosate									
Species	Test duration	IC50 / EC50			NOEC			Formulation	Reference
		(mg a.i L ⁻¹)	(mg RU L ⁻¹)	(mg a.e L ⁻¹)	(mg a.i L ⁻¹)	(mg RU L ⁻¹)	(mg a.e L ⁻¹)		
<i>Anabaena flos-aquae</i>	7 d			15			9.7	Glyphosate	Malcolm Pirnie, 1987a
<i>Ankistrodesmus sp.</i>	4 d	412		309	20		15.0	Glyphosate (tested as IPA salt)	Gardner et al., 1997
<i>Chlamydomonas eugametos</i>	4 d			> 169			16.9	Glyphosate	Hess, 1980
<i>Chlorella pyrenoidosa</i>	4 d			3.53				Glyphosate (TC: technical product)	Ma, 2002
<i>Chlorella pyrenoidosa</i>	4 d			590				Glyphosate	Maule and Wright, 1984
<i>Chlorella pyrenoidosa</i>	7 d		189	58.6				Roundup®	Hernando et al., 1989
<i>Chlorella saccharophila</i>	3 d			26				Glyphosate (Analytical Standard)	Vendrell et al., 2009
<i>Chlorella sorokiniana</i>	4 d		3	0.9		2	0.6	Roundup®	Christy et al., 1981
<i>Chlorella vulgaris</i>	3 d			24.5				Glyphosate (Analytical Standard)	Vendrell et al., 2009
<i>Chlorococcum hypnosporum</i>	4 d			68				Glyphosate	Maule and Wright, 1984
<i>Navicula pelliculosa</i>	7 d			42			33.6	Glyphosate	Malcolm Pirnie, 1987c
<i>Scenedesmus acutus</i>	4 d			10.2			2	Glyphosate	Saenz et al., 1997
<i>Scenedesmus acutus</i>	3 d			40.6				Glyphosate (Analytical Standard)	Vendrell et al., 2009
<i>Scenedesmus obliquos</i>	4 d			55.85				Glyphosate (TC: technical product)	Ma, 2002
<i>Scenedesmus quadricauda</i>	4 d			7.2			0.77	Glyphosate	Saenz et al., 1997
<i>Scenedesmus subspicatus</i>	3 d			41.7				Glyphosate (Analytical Standard)	Vendrell et al., 2009
<i>Scenedesmus subspicatus</i>	3 d	72.9		54.7	10.5		7.88	Glyphosate (tested as IPA salt)	Dengler and Mende, 1994b
<i>Scenedesmus subspicatus</i>	3 d	166		125	26.4		19.80	Glyphosate (tested as IPA salt)	Dengler and Mende, 1994b
<i>Selenastrum capricornutum</i>	4 d		2.6	0.8				Roundup®	Thomas et al., 1990
<i>Selenastrum capricornutum</i>	3 d		2.1	0.7		0.73	0.23	Roundup®	LISEC, 1989
<i>Selenastrum capricornutum</i>	3 d		8	2.5				Roundup®	LISEC, 1989
<i>Selenastrum capricornutum</i>	4 d			5.81				Roundup®	Tsui and Chu, 2003
<i>Selenastrum capricornutum</i>	4 d			24.7				Glyphosate Technical grade	Tsui and Chu, 2003
<i>Selenastrum capricornutum</i>	4 d			41				Glyphosate (tested as IPA salt)	Tsui and Chu, 2003
<i>Selenastrum capricornutum</i>	4 d			21.8 or 26.3				Glyphosate	Bozeman et al., 1989
<i>Selenastrum capricornutum</i>	3 d			485			45	Glyphosate	NATEC, 1990

AQUATIC MICROORGANISMS									
Glyphosate									
Species	Test duration	IC50 / EC50			NOEC			Formulation	Reference
		(mg a.i L ⁻¹)	(mg RU L ⁻¹)	(mg a.e L ⁻¹)	(mg a.i L ⁻¹)	(mg RU L ⁻¹)	(mg a.e L ⁻¹)		
<i>Selenastrum capricornutum</i>	7 d			13.8			10.6	Glyphosate	Malcolm Pimie, 1987b
<i>Tetrahymena pyriformis</i>	40 h			29.5				Roundup®	Tsui and Chu, 2003
<i>Tetrahymena pyriformis</i>	40 h			648				Glyphosate Technical grade	Tsui and Chu, 2003
<i>Tetrahymena pyriformis</i>	40 h			386				Glyphosate (tested as IPA salt)	Tsui and Chu, 2003
<i>Tetrahymena pyriformis</i>	9 h			>500				Glyphosate (Fluka)	Bonnet et al., 2007
AMPA									
Species	Test Duration	IC50 / EC50		NOEC		Formulation	Reference		
		(mg AMPA L ⁻¹)		(mg AMPA L ⁻¹)					
<i>Scenedesmus subspicatus</i>	3 d	90		7,9		AMPA (Analytical Standard)	Dengler and Mende, 1994a		
<i>Tetrahymena pyriformis</i>	9 h	>5000				AMPA (Analytical Standard, Fluka)	Bonnet, 2007		

IC50: median inhibitory concentration, EC50: median effective concentration, NOEC: no observed effects concentration, RU: Roundup. Bold value indicates lower NOEC for aquatic organisms.

Table S2: Toxicity of Glyphosate and AMPA to aquatic microorganisms.

AQUATIC INVERTEBRATES										
Glyphosate										
Species	Life stage	Test duration	LC50 / EC50			NOEC			Formulation	Reference
			(mg a.i L ⁻¹)	(mg RU L ⁻¹)	(mg a.e L ⁻¹)	(mg a.i L ⁻¹)	(mg RU L ⁻¹)	(mg a.e L ⁻¹)		
<i>Anopheles quadrimaculatus</i>	Larvae	1 d		673.4	208.8				Roundup®	Holck and Meek, 1987
<i>Ceriodaphnia dubia</i>		2 d			5.39				Roundup®	Tsui and Chu 2003
<i>Ceriodaphnia dubia</i>		2 d			147				Glyphosate Technical grade	Tsui and Chu 2003
<i>Ceriodaphnia dubia</i>		2 d			415				Glyphosate (tested as IPA salt)	Tsui and Chu, 2003
<i>Daphnia magna</i>		2 d		24	7		7.8	2.4	Roundup®	EG & G Bionomics, 1980f
<i>Daphnia magna</i>		2 d		12.9	4.0		4.6	1.4	Roundup®	EG & G Bionomics, 1980e
<i>Daphnia magna</i>		2 d			780			560	Glyphosate (tested as acid)	ABC Inc., 1978a
<i>Daphnia magna</i>		2 d	930		698	320		240	Glyphosate (tested as IPA salt)	ABC Inc., 1981a
<i>Daphnia magna</i>		21 d					3.2	1.0	Roundup®	ABC Inc., 1989b
<i>Daphnia magna</i>		21 d						100	Glyphosate	ABC Inc., 1989c
<i>Daphnia magna</i>		21 d						50	Glyphosate	ABC Inc., 1982d
<i>Daphnia magna</i>		2 d		9.7	3.0				Roundup®	Folmar et al., 1979 Hartman and Martin, 1984
<i>Daphnia pulex</i>		2 d		19	6				Roundup®	
<i>Daphnia pulex</i>		4 d		25.5	7.9				Roundup®	Servizi et al., 1987
<i>Gammarus pseudolimnaeus</i>		2 d		42	13		4.4	1.4	Roundup®	ABC Inc., 1982b
<i>Gammarus pseudolimnaeus</i>		2 d		200	62				Roundup®	Folmar et al., 1979
<i>Gammarus pseudolimnaeus</i>		4 d		138.7	43.0				Roundup®	Folmar et al., 1979
<i>Hyalella azteca</i>		10 d	>530		397.5	265		199	Glyphosate (tested as IPA salt)	Beyers, 1993
<i>Lampsilis siliquioidea</i>	Glochidia	24 h			3				Roundup®	Bringolf et al., 2007
<i>Lampsilis siliquioidea</i>	Glochidia	48 h			2.9				Roundup®	Bringolf et al., 2007
<i>Lampsilis siliquioidea</i>	Juvenile	48 h			5.9				Roundup®	Bringolf et al., 2007
<i>Lampsilis siliquioidea</i>	Juvenile	96 h			5.9				Roundup®	Bringolf et al., 2007
<i>Lampsilis siliquioidea</i>	Juvenile	7 d			>7.4				Roundup®	Bringolf et al., 2007
<i>Lampsilis siliquioidea</i>	Juvenile	14 d			>7.4				Roundup®	Bringolf et al., 2007
<i>Lampsilis siliquioidea</i>	Juvenile	21 d			6				Roundup®	Bringolf et al., 2007

AQUATIC INVERTEBRATES

Glyphosate

Species	Life stage	Test duration	LC50 / EC50			NOEC			Formulation	Reference
			(mg a.i L ⁻¹)	(mg RU L ⁻¹)	(mg a.e L ⁻¹)	(mg a.i L ⁻¹)	(mg RU L ⁻¹)	(mg a.e L ⁻¹)		
<i>Lampsilis siliquioidea</i>	Juvenile	28 d			3.7				Roundup®	Bringolf et al., 2007
<i>Lampsilis siliquioidea</i>	Glochidia	24 h			>148				Aqua Star (active ingredient: 53.8% glyphosate IPA salt)	Bringolf et al., 2007
<i>Lampsilis siliquioidea</i>	Glochidia	48 h			>148				Aqua Star (active ingredient: 53.8% glyphosate IPA salt)	Bringolf et al., 2007
<i>Lampsilis siliquioidea</i>	Juvenile	48 h			>148				Aqua Star (active ingredient: 53.8% glyphosate IPA salt)	Bringolf et al., 2007
<i>Lampsilis siliquioidea</i>	Juvenile	96 h			>148				Aqua Star (active ingredient: 53.8% glyphosate IPA salt)	Bringolf et al., 2007
<i>Lampsilis siliquioidea</i>	Juvenile	7 d			>148				Aqua Star (active ingredient: 53.8% glyphosate IPA salt)	Bringolf et al., 2007
<i>Lampsilis siliquioidea</i>	Juvenile	14 d			>148				Aqua Star (active ingredient: 53.8% glyphosate IPA salt)	Bringolf et al., 2007
<i>Lampsilis siliquioidea</i>	Juvenile	21 d			957.3				Aqua Star (active ingredient: 53.8% glyphosate IPA salt)	Bringolf et al., 2007
<i>Lampsilis siliquioidea</i>	Juvenile	28 d			43.8				Aqua Star (active ingredient: 53.8% glyphosate IPA salt)	Bringolf et al., 2007
<i>Lampsilis siliquioidea</i>	Glochidia	24 h			>200				Glyphosate (technical grade)	Bringolf et al., 2007
<i>Lampsilis siliquioidea</i>	Glochidia	48 h			>200				Glyphosate (technical grade)	Bringolf et al., 2007
<i>Lampsilis siliquioidea</i>	Juvenile	48 h			>200				Glyphosate (technical grade)	Bringolf et al., 2007
<i>Lampsilis siliquioidea</i>	Juvenile	96 h			>200				Glyphosate (technical grade)	Bringolf et al., 2007
<i>Lampsilis siliquioidea</i>	Juvenile	7 d			>200				Glyphosate (technical grade)	Bringolf et al., 2007
<i>Lampsilis siliquioidea</i>	Juvenile	14 d			>200				Glyphosate (technical grade)	Bringolf et al., 2007
<i>Lampsilis siliquioidea</i>	Juvenile	21 d			>200				Glyphosate (technical grade)	Bringolf et al., 2007
<i>Lampsilis siliquioidea</i>	Glochidia	24 h			5.9				Glyphosate IPA (technical grade)	Bringolf et al., 2007
<i>Lampsilis siliquioidea</i>	Glochidia	48 h			5				Glyphosate IPA (technical grade)	Bringolf et al., 2007
<i>Lampsilis siliquioidea</i>	Juvenile	48 h			8.3				Glyphosate IPA (technical grade)	Bringolf et al., 2007
<i>Lampsilis siliquioidea</i>	Juvenile	96 h			7.2				Glyphosate IPA (technical grade)	Bringolf et al., 2007
<i>Lampsilis siliquioidea</i>	Juvenile	7 d			7.6				Glyphosate IPA (technical grade)	Bringolf et al., 2007
<i>Lampsilis siliquioidea</i>	Juvenile	14 d			6.9				Glyphosate IPA (technical grade)	Bringolf et al., 2007
<i>Lampsilis siliquioidea</i>	Juvenile	21 d			5.4				Glyphosate IPA (technical grade)	Bringolf et al., 2007
<i>Lampsilis siliquioidea</i>	Juvenile	28 d			4.8				Glyphosate IPA (technical grade)	Bringolf et al., 2007
<i>Lampsilis siliquioidea</i>	Glochidia	24 h			6				Glyphosate (tested as IPA salt)	Bringolf et al., 2007
<i>Lampsilis siliquioidea</i>	Glochidia	48 h			4.6				Glyphosate (tested as IPA salt)	Bringolf et al., 2007

AQUATIC INVERTEBRATES										
Glyphosate										
Species	Life stage	Test duration	LC50 / EC50			NOEC			Formulation	Reference
			(mg a.i L ⁻¹)	(mg RU L ⁻¹)	(mg a.e L ⁻¹)	(mg a.i L ⁻¹)	(mg RU L ⁻¹)	(mg a.e L ⁻¹)		
<i>Lampsilis siliquioidea</i>	Juvenile	48 h			9.9				Glyphosate (tested as IPA salt)	Bringolf et al., 2007
<i>Lampsilis siliquioidea</i>	Juvenile	96 h			6.3				Glyphosate (tested as IPA salt)	Bringolf et al., 2007
<i>Orconectes nais</i>		4 d		7	2				Roundup®	Mayer and Ellersieck, 1986
<i>Procambarus clarkii</i>		4 d		47.3	14.7				Roundup®	Holck and Meek, 1987
<i>Pseudosuccinea columella</i>		n.r			98.9				Glyphosate (tested as acid)	Thompson, 1989
<i>Scapholeberis kingi</i>		0,125 d		61	19				Roundup®	Sun, 1987
AMPA										
Species	Life stage	Test Duration	LC50 / EC50			NOEC			Formulation	Reference
			(mg AMPA L ⁻¹)			(mg AMPA L ⁻¹)				
<i>Daphnia magna</i>		2 dias		690			320		AMPA (Analytical Standard)	ABC Inc., 1991a

LC50: median lethal concentration, EC50: median effective concentration, NOEC: no observed effects concentration, RU: Roundup. Bold value indicates lower NOEC for aquatic invertebrates.

Table S3: Toxicity of Glyphosate and AMPA to fish.

FISH										
Glyphosate										
Species	Life stage	Test duration	LC50			NOEC			Formulation	Reference
			(mg a.i L ⁻¹)	(mg RU L ⁻¹)	(mg a.e L ⁻¹)	(mg a.i L ⁻¹)	(mg RU L ⁻¹)	(mg a.e L ⁻¹)		
<i>Cyprinodon variegatus</i>		4 d			>1000			1000	Glyphosate (tested as acid)	EG & G Bionomics, 1978
<i>Cyprinus carpio</i>		4 d		10	3		5.6	1.7	Roundup®	Liong et al., 1988
<i>Cyprinus carpio</i>		4 d		15	5				Roundup®	Tooby et al., 1980
<i>Cyprinus carpio</i>		4 d		26	8				Roundup®	Sun, 1987
<i>Gambusia affinis</i>		2 d		15	5				Roundup®	Sun, 1987
<i>Hybognathus placitus</i>		4 d	>648		>486	648		486	Glyphosate (tested as IPA salt)	Beyers, 1995
<i>Ictalurus punctatus</i>	Adult	4 d		42	13				Roundup®	Folmar et al., 1979
<i>Ictalurus punctatus</i>	Fry	4 d		10.6	3.3				Roundup®	Folmar et al., 1979
<i>Ictalurus punctatus</i>		4 d		39	12		23	7	Roundup®	EG & G Bionomics, 1980a
<i>Jenynsia multidentata</i>		96h		19.02	5.8962				Roundup®	Hued et al., 2012
<i>Lepomis macrochirus</i>		4 d		16.1	5.0				Roundup®	Folmar et al., 1979
<i>Lepomis macrochirus</i>		2 d			>24			24	Glyphosate (tested as acid)	Bionomics, 1973
<i>Lepomis macrochirus</i>		4 d			120			100	Glyphosate (tested as acid)	ABC Inc., 1978c
<i>Lepomis macrochirus</i>		4 d	140-220		105-165				Glyphosate (tested as IPA salt)	Folmar et al., 1979
<i>Lepomis macrochirus</i>		4 d	>1000		>750	560		420	Glyphosate (tested as IPA salt)	ABC Inc., 1981b
<i>Lepomis macrochirus</i>		4 d		34	11		21	7	Roundup®	EG & G Bionomics, 1980b
<i>Lepomis macrochirus</i>		4 d		5.8	1.8		2.2	0.7	Roundup®	ABC Inc., 1982a
<i>Ictalurus punctatus</i>		4 d	130		97.5				Glyphosate (tested as IPA salt)	Folmar et al., 1979
<i>Iordanella floridae</i>	Juvenile	4 d			>30				Glyphosate (tested as acid)	Holdway and Dixon, 1988
<i>Oncorhynchus gorbuscha</i> (hard water)		4 d		14	4				Roundup®	Wan et al., 1989
<i>Oncorhynchus gorbuscha</i> (soft water)		4 d		31	10				Roundup®	Wan et al., 1989
<i>Oncorhynchus gorbuscha</i> (hard water)		4 d			190				Glyphosate (tested as acid)	Wan et al., 1989
<i>Oncorhynchus gorbuscha</i> (soft water)		4 d			23				Glyphosate (tested as acid)	Wan et al., 1989
<i>Oncorhynchus keta</i> (hard water)		4 d		11	3.4				Roundup®	Wan et al., 1989
<i>Oncorhynchus keta</i> (soft water)		4d		19	6				Roundup®	Wan et al., 1989
<i>Oncorhynchus keta</i> (hard water)		4 d			148				Glyphosate (tested as acid)	Wan et al., 1989

FISH											
Glyphosate											
Species	Life stage	Test duration	LC50			NOEC			Formulation	Reference	
			(mg a.i L ⁻¹)	(mg RU L ⁻¹)	(mg a.e L ⁻¹)	(mg a.i L ⁻¹)	(mg RU L ⁻¹)	(mg a.e L ⁻¹)			
<i>Oncorhynchus keta</i> (soft water)	Fry	4 d			22				Glyphosate (tested as acid)	Wan et al., 1989	
<i>Oncorhynchus kisutch</i>		4 d		42	13				Roundup®	Servizi et al., 1987	
<i>Oncorhynchus kisutch</i>		4 d		22	7				Roundup®	Mitchell et al., 1987	
<i>Oncorhynchus kisutch</i> (hard water)		4 d				174			Glyphosate (tested as acid)	Wan et al., 1989	
<i>Oncorhynchus kisutch</i> (soft water)		4 d				36			Glyphosate (tested as acid)	Wan et al., 1989	
<i>Oncorhynchus kisutch</i> (hard water)		4 d		13	4.0				Roundup®	Wan et al., 1989	
<i>Oncorhynchus kisutch</i> (soft water)		4 d		27	8.4				Roundup®	Wan et al., 1989	
<i>Oncorhynchus mykiss</i>		Fingerling	4 d		8.2	2.5		6.4	2.0	Roundup®	ABC Inc., 1982c
<i>Oncorhynchus mykiss</i>			4 d		22	7		8	2.5	Roundup®	EG & G Bionomics 1980g
<i>Oncorhynchus mykiss</i>			4 d		27	8		6.75	2.1	Roundup®	Morgan et al., 1991
<i>Oncorhynchus mykiss</i>	4 d			27	8		21.4	6.6	Roundup®	EG & G Bionomics, 1980c	
<i>Oncorhynchus mykiss</i>	4 d			4.2-27	1.3-8.4				Roundup®	Folmar et al., 1979	
<i>Oncorhynchus mykiss</i>	4 d			52	16				Roundup®	Hildebrand et al., 1982	
<i>Oncorhynchus mykiss</i>	4 d			15	5				Roundup®	Mitchell et al., 1987	
<i>Oncorhynchus mykiss</i>	4 d			33.6	10.4				Roundup®	Morgan and Kiceniuk, 1992	
<i>Oncorhynchus mykiss</i>	4 d				86			42	Glyphosate (tested as acid)	ABC Inc., 1978b	
<i>Oncorhynchus mykiss</i>	4 d			>1000	>750	1000		750	Glyphosate (tested as IPA salt)	ABC Inc., 1981c	
<i>Oncorhynchus mykiss</i>	4 d		140-240	105-180				Glyphosate (tested as IPA salt)	Folmar et al., 1979		
<i>Oncorhynchus mykiss</i>	21 d					2.4	0.744	Roundup®	ABC Inc., 1989d		
<i>Oncorhynchus mykiss</i>	21 d						52	Glyphosate	ABC Inc. 1989a		
<i>Oncorhynchus mykiss</i> (hard water)	4 d				197			Glyphosate (tested as acid)	Wan et al., 1989		
<i>Oncorhynchus mykiss</i> (soft water)	4 d				22			Glyphosate (tested as acid)	Wan et al., 1989		
<i>Oncorhynchus mykiss</i> (hard water)	4 d		14	4				Roundup®	Wan et al., 1989		
<i>Oncorhynchus mykiss</i> (soft water)	4 d		15	5				Roundup®	Wan et al., 1989		
<i>Oncorhynchus nerka</i>	4 d		26.7	8.3				Roundup®	Servizi et al., 1987		

FISH										
Glyphosate										
Species	Life stage	Test duration	LC50			NOEC			Formulation	Reference
			(mg a.i L ⁻¹)	(mg RU L ⁻¹)	(mg a.e L ⁻¹)	(mg a.i L ⁻¹)	(mg RU L ⁻¹)	(mg a.e L ⁻¹)		
<i>Oncorhynchus tshawytscha</i>		4 d		20	6				Roundup®	Mitchell et al., 1987
<i>Oncorhynchus tshawytscha</i> (soft water)		4d		27	8				Roundup®	Wan et al., 1989
<i>Oncorhynchus tshawytscha</i> (hard water)		4 d		17	5				Roundup®	Wan et al., 1989
<i>Oncorhynchus tshawytscha</i> (hard water)		4 d			211				Glyphosate (tested as acid)	Wan et al., 1989
<i>Oncorhynchus tshawytscha</i> (soft water)		4 d			30				Glyphosate (tested as acid)	Wan et al., 1989
<i>Pimephales promelas</i>		4 d		23	7		13.6	4.2	Roundup®	EG & G Bionomics, 1980d
<i>Pimephales promelas</i>		4 d	97		72.75				Glyphosate (tested as IPA salt)	Folmar et al., 1979
<i>Pimephales promelas</i>		255 d						26	Glyphosate	EG & G Bionomics, 1975
<i>Pimephales promelas</i>		4 d		7.4	2.3				Roundup®	Folmar et al., 1979
<i>Pimephales promelas</i>		4 d	>648		>486	648		486	Glyphosate (tested as IPA salt)	Beyers, 1995
<i>Prochilodus lineatus</i>	Juvenile	6 h		20.8	6.5				Roundup®	Langiano and Martinez, 2008
<i>Prochilodus lineatus</i>	Juvenile	24 h		17.3	5.4				Roundup®	Langiano and Martinez, 2008
<i>Prochilodus lineatus</i>	Juvenile	96 h		13.7	4.2				Roundup®	Langiano and Martinez, 2008
<i>Rasbora heteromorpha</i>		4 d			168			<100	Glyphosate (tested as acid)	HRC, 1977
<i>Rhamdia quelen</i>	Fingerlings	96h			7.3				Roundup®	Kreutz et al., 2008
<i>Tilapia sp.</i>		4 d		7.4	2.3		1	0.31	Roundup®	Liong et al., 1988
AMPA										
Species	Life stage	Test Duration	LC50			NOEC			Formulation	Reference
			(mg AMPA L ⁻¹)			(mg AMPA L ⁻¹)				
<i>Oncorhynchus mykiss</i>		4 d	520			33			AMPA	ABC Inc., 1991b

LC50: median lethal concentration, NOEC: no observed effects concentration, RU: Roundup. Bold value indicates lower NOEC for fish.

Table S4: Toxicity of Glyphosate and AMPA to amphibians.

AMPHIBIANS											
Glyphosate											
Species	Life stage	Test duration	LC50			NOEC			LOEC	Formulation	Reference
			(mg a.i L ⁻¹)	(mg RU L ⁻¹)	(mg a.e L ⁻¹)	(mg a.i L ⁻¹)	(mg RU L ⁻¹)	(mg a.e L ⁻¹)	(mg a.e L ⁻¹)		
<i>Ambystoma gracile</i>		96 h			2.8					Roundup Original Max	Relyea and Jones, 2009
<i>Ambystoma laterale</i>		96 h			3.2					Roundup Original Max	Relyea and Jones, 2009
<i>Ambystoma maculatum</i>		96 h			2.8					Roundup Original Max	Relyea and Jones, 2009
American toads	Tadpole	16 d	2.52		1.89					Roundup®	Relyea, 2005
<i>Bufo americanus</i>	Larvae	24 h			4.2					Roundup Original	Howe et al., 2004
<i>Bufo americanus</i>	Larvae	96 h			<4					Roundup Original	Howe et al., 2004
<i>Bufo americanus</i>	Embryo	24 h			>8					Roundup Original	Howe et al., 2004
<i>Bufo americanus</i>	Embryo	96 h			8					Roundup Original	Howe et al., 2004
<i>Bufo americanus</i>	Embryo	96 h (pH=6)			4.8					Vision (glyphosate-based herbicide containing a 15% (weight:weight) polyethoxylated tallow amine surfactant blend)	Edginton et al., 2004
<i>Bufo americanus</i>	Embryo	96 h (pH=7.5)			6.4					Vision (glyphosate-based herbicide containing a 15% (weight:weight) polyethoxylated tallow amine surfactant blend)	Edginton et al., 2004
<i>Bufo americanus</i>	Larvae	96 h (pH=6)			2.9					Vision (glyphosate-based herbicide containing a 15% (weight:weight) polyethoxylated tallow amine surfactant blend)	Edginton et al., 2004
<i>Bufo americanus</i>	Larvae	96 h (pH=7.5)			1.7					Vision (glyphosate-based herbicide containing a 15% (weight:weight) polyethoxylated tallow amine surfactant blend)	Edginton et al., 2004
<i>Bufo americanus</i>	Larvae	96 h			1.6					Roundup Original Max	Relyea and Jones, 2009
<i>Bufo boreas</i>	Larvae	96 h			2					Roundup Original Max	Relyea and Jones, 2009
<i>Bufo fowleri</i>	Larvae	96 h			4.21		3.4			Roundup®	Moore et al., 2012
<i>Bufo fowleri</i>	Larvae	96 h			4.21		3.4	3.95		Roundup Original	Fuentes et al., 2011
<i>Bufo fowleri</i>	Larvae	96 h			1.96		1.54	1.56		Roundup WeatherMAX	Fuentes et al., 2011
<i>Crinia insignifera</i>	Tadpole	2 d		10	3					Roundup®	Mann and Bidwell, 1999
<i>Crinia insignifera</i>	Newly emerged	2 d		144	45					Roundup®	Mann and Bidwell, 1999
<i>Crinia insignifera</i>	Adult	2 d		137	42					Roundup®	Mann and Bidwell, 1999
<i>Crinia insignifera</i>	Tadpole	2 d		<54.9	<17					Roundup®	Bidwell and Gorrie, 1995
<i>Crinia insignifera</i>	Adult	4 d		96.8	30.0	54	16.74			Roundup®	Bidwell and Gorrie, 1995
<i>Crinia insignifera</i>	Newly emerged	2 d			83.6					Glyphosate (tested as acid)	Mann and Bidwell, 1999
<i>Crinia insignifera</i>	Adult	4 d			78		45			Glyphosate (tested as acid)	Bidwell and Gorrie, 1995

AMPHIBIANS

Glyphosate

Species	Life stage	Test duration	LC50			NOEC			LOEC	Formulation	Reference
			(mg a.i L ⁻¹)	(mg RU L ⁻¹)	(mg a.e L ⁻¹)	(mg a.i L ⁻¹)	(mg RU L ⁻¹)	(mg a.e L ⁻¹)	(mg a.e L ⁻¹)		
<i>Crinia insignifera</i>	Tadpole	2 d	>466		>350					Glyphosate (tested as IPA salt)	Mann and Bidwell, 1999
<i>Heleioporus eyrei</i>	Tadpole	2 d		17.5	5.4					Roundup®	Mann and Bidwell, 1999
<i>Heleioporus eyrei</i>	tadpole	2 d	>373		>279					Glyphosate (tested as IPA salt)	Mann and Bidwell, 1999
<i>Hyla chrysoscelis</i>	Larvae	96 h			2.5		1.74			Roundup®	Moore et al., 2012
<i>Hyla chrysoscelis</i>	Larvae	96h			3.26		2.48	2.87		Roundup WeatherMAX	Fuentes et al., 2011
<i>Hyla chrysoscelis</i>	Larvae	96h			2.5		1.74	2.1		Roundup Original	Fuentes et al., 2011
<i>Hyla versicolor</i>	Larvae	96 h			1.7					Roundup Original Max	Relyea and Jones, 2009
<i>Hyla versicolor</i>	Tadpole	16 d	1.35		1.01					Roundup®	Relyea, 2005
<i>Leopard frogs</i>	Tadpole	16 d	2.46		1.85					Roundup®	Relyea, 2005
<i>Limnodynastes dorsalis</i>	Tadpole	2 d		8.3	2.60					Roundup®	Mann and Bidwell, 1999
<i>Limnodynastes dorsalis</i>	Tadpole	2 d	>400		>300					Glyphosate (tested as IPA salt)	Mann and Bidwell, 1999
<i>Litoria moorei</i>	Tadpole	2 d		8.1	2.5					Roundup®	Mann and Bidwell, 1999
<i>Litoria moorei</i>	Tadpole	2 d		32.2	10.0					Roundup®	Mann and Bidwell, 1999
<i>Litoria moorei</i>	Tadpole	4 d		18.7	5.8	5.5	1.705			Roundup®	Bidwell and Gorrie, 1995
<i>Litoria moorei</i>	Adult	4 d		>165	>51	165	51			Roundup®	Bidwell and Gorrie, 1995
<i>Litoria moorei</i>	Tadpole	2 d			121					Glyphosate (tested as acid)	Mann and Bidwell, 1999
<i>Litoria moorei</i>	Tadpole	2 d			81.2					Glyphosate (tested as acid)	Mann and Bidwell, 1999
<i>Litoria moorei</i>	Tadpole	4 d			111					Glyphosate (tested as acid)	Bidwell and Gorrie, 1995
<i>Litoria moorei</i>	Adult	4 d			>180		180			Glyphosate (tested as acid)	Bidwell and Gorrie, 1995
<i>Litoria moorei</i>	Tadpole	2 d	>343		>257					Glyphosate (tested as IPA salt)	Mann and Bidwell, 1999
<i>Notophthalmus viridescens</i>		96 h			2.7					Roundup Original Max	Relyea and Jones, 2009
<i>Pseudacris crucifer</i>	Larvae	96 h			0.8					Roundup Original Max	Relyea and Jones, 2009
<i>Rana cascadae</i>	Larvae	96 h			1.7					Roundup Original Max	Relyea and Jones, 2009
<i>Rana catesbeiana</i>	Larvae	96 h			2.77		2.02			Roundup®	Moore et al., 2012
<i>Rana catesbeiana</i>	Larvae	96 h			0.8					Roundup Original Max	Relyea and Jones, 2009
<i>Rana catesbeiana</i>	Larvae	96 h			2.77		2.02	2.52		Roundup Original	Fuentes et al., 2011
<i>Rana catesbeiana</i>	Larvae	96h			1.97		1.33	1.37		Roundup WeatherMAX	Fuentes et al., 2011
<i>Rana clamitans</i>	Larvae	24 h			2					Roundup Original	Howe et al., 2004
<i>Rana clamitans</i>	Larvae	96 h			2					Roundup Original	Howe et al., 2004
<i>Rana clamitans</i>	Embryo	24 h			>8					Roundup Original	Howe et al., 2004
<i>Rana clamitans</i>	Embryo	96 h			7.1					Roundup Original	Howe et al., 2004
<i>Rana clamitans</i>	Larvae	24 h			>17.9					Roundup Biactive	Howe et al., 2004
<i>Rana clamitans</i>	Larvae	96 h			>17.9					Roundup Biactive	Howe et al., 2004
<i>Rana clamitans</i>	Larvae	24 h			>17.9					Touchdown	Howe et al., 2004
<i>Rana clamitans</i>	Larvae	96 h			>17.9					Touchdown	Howe et al., 2004
<i>Rana clamitans</i>	Larvae	24 h			>17.9					Glyfos BIO	Howe et al., 2004
<i>Rana clamitans</i>	Larvae	96 h			>17.9					Glyfos BIO	Howe et al., 2004
<i>Rana clamitans</i>	Larvae	24 h			9					Glyfos AU	Howe et al., 2004
<i>Rana clamitans</i>	Larvae	96 h			8.9					Glyfos AU	Howe et al., 2004

AMPHIBIANS

Glyphosate

Species	Life stage	Test duration	LC50			NOEC			LOEC	Formulation	Reference
			(mg a.i L ⁻¹)	(mg RU L ⁻¹)	(mg a.e L ⁻¹)	(mg a.i L ⁻¹)	(mg RU L ⁻¹)	(mg a.e L ⁻¹)	(mg a.e L ⁻¹)		
<i>Rana clamitans</i>	Larvae	24 h			2.3					Roundup Transorb	Howe et al., 2004
<i>Rana clamitans</i>	Larvae	96 h			2.2					Roundup Transorb	Howe et al., 2004
<i>Rana clamitans</i>	Embryo	96 h (pH=6)			5.3					Vision (glyphosate-based herbicide containing a 15% (weight:weight) polyethoxylated tallow amine surfactant blend)	Edginton et al., 2004
<i>Rana clamitans</i>	Embryo	96 h (pH=7.5)			4.1					Vision (glyphosate-based herbicide containing a 15% (weight:weight) polyethoxylated tallow amine surfactant blend)	Edginton et al., 2004
<i>Rana clamitans</i>	Larvae	96 h (pH=6)			3.5					Vision (glyphosate-based herbicide containing a 15% (weight:weight) polyethoxylated tallow amine surfactant blend)	Edginton et al., 2004
<i>Rana clamitans</i>	Larvae	96 h (pH=7.5)			1.4					Vision (glyphosate-based herbicide containing a 15% (weight:weight) polyethoxylated tallow amine surfactant blend)	Edginton et al., 2004
<i>Rana clamitans</i>	Larvae	96h			4.22		3.27	3.68		Roundup Original	Fuentes et al., 2011
<i>Rana clamitans</i>	Larvae	24 h			>17.9					Glyphosate Technical	Howe et al., 2004
<i>Rana clamitans</i>	Larvae	96 h			>17.9					Glyphosate Technical	Howe et al., 2004
<i>Rana clamitans</i>	Tadpole	16 d	2.17		1.6275					Roundup®	Relyea, 2005
<i>Rana clamitans</i>	Larvae	96 h			1.4					Roundup Original Max	Relyea and Jones, 2009
<i>Rana clamitans</i>	Larvae	96 h			4.34					Vision (glyphosate, 356 mg acid equivalents (a.e.)/L)	Wojtaszek et al., 2004
<i>Rana clamitans</i>	Larvae	96 h			2.7					Vision (glyphosate, 356 mg acid equivalents (a.e.)/L)	Wojtaszek et al., 2004
<i>Rana clamitans</i>	Larvae	96 h			2.77		1.91	2.37		Roundup WeatherMAX	Fuentes et al., 2011
<i>Rana clamitans</i>	Larvae	96 h			4.22		3.27			Roundup®	Moore et al., 2012
<i>Rana pipiens</i>	Larvae	24 h			3.7					Roundup Original	Howe et al., 2004
<i>Rana pipiens</i>	Larvae	96 h			2.9					Roundup Original	Howe et al., 2004
<i>Rana pipiens</i>	Embryo	24 h			>8					Roundup Original	Howe et al., 2004
<i>Rana pipiens</i>	Embryo	96 h			6.5					Roundup Original	Howe et al., 2004
<i>Rana pipiens</i>	Embryo	96 h (pH=6)			15.1					Vision (glyphosate-based herbicide containing a 15% (weight:weight) polyethoxylated tallow amine surfactant blend)	Edginton et al., 2004
<i>Rana pipiens</i>	Embryo	96 h (pH=7.5)			7.5					Vision (glyphosate-based herbicide containing a 15% (weight:weight) polyethoxylated tallow amine surfactant blend)	Edginton et al., 2004

AMPHIBIANS											
Glyphosate											
Species	Life stage	Test duration	LC50			NOEC			LOEC	Formulation	Reference
			(mg a.i L ⁻¹)	(mg RU L ⁻¹)	(mg a.e L ⁻¹)	(mg a.i L ⁻¹)	(mg RU L ⁻¹)	(mg a.e L ⁻¹)	(mg a.e L ⁻¹)		
<i>Rana pipiens</i>	Larvae	96 h (pH=6)			1.8					Vision (glyphosate-based herbicide containing a 15% (weight:weight) polyethoxylated tallow amine surfactant blend)	Edginton et al., 2004
<i>Rana pipiens</i>	Larvae	96 h (pH=7.5)			1.1					Vision (glyphosate-based herbicide containing a 15% (weight:weight) polyethoxylated tallow amine surfactant blend)	Edginton et al., 2004
<i>Rana pipiens</i>	Larvae	96 h			11.47					Vision (glyphosate, 356 mg acid equivalents (a.e.)/L)	Wojtaszek et al., 2004
<i>Rana pipiens</i>	Larvae	96 h			4.25					Vision (glyphosate, 356 mg acid equivalents (a.e.)/L)	Wojtaszek et al., 2004
<i>Rana pipiens</i>	Larvae	96 h			1.8		1.29	1.32		Roundup Original	Fuentes et al., 2011
<i>Rana pipiens</i>	Larvae	96 h			1.5					Roundup Original Max	Relyea and Jones, 2009
<i>Rana pipiens</i>	Larvae	96 h			1.8		1.29			Roundup®	Moore et al., 2012
<i>Rana pipiens</i>	Larvae	96 h			2.27		1.65	1.68		Roundup WeatherMAX	Fuentes et al., 2011
<i>Rana sphenoccephala</i>	Larvae	96 h			1.33		0.68	0.98		Roundup WeatherMAX	Fuentes et al., 2011
<i>Rana sphenoccephala</i>	Larvae	96 h			2.05		1.52	1.81		Roundup Original	Fuentes et al., 2011
<i>Rana sylvatica</i>	Larvae	24 h			5.6					Roundup Original	Howe et al., 2004
<i>Rana sylvatica</i>	Larvae	96 h			5.1					Roundup Original	Howe et al., 2004
<i>Rana sylvatica</i>	Embryo	24 h			>8					Roundup Original	Howe et al., 2004
<i>Rana sylvatica</i>	Embryo	96 h			>8					Roundup Original	Howe et al., 2004
<i>Rana sylvatica</i>	Larvae	96 h			1.9					Roundup Original Max	Relyea and Jones, 2009
<i>Rhinella arenarum</i>	Tadpole	6 h			5.62					Roundup Ultra-Max	Lajmanovich et al., 2011
<i>Rhinella arenarum</i>	Tadpole	12 h			3.26					Roundup Ultra-Max	Lajmanovich et al., 2011
<i>Rhinella arenarum</i>	Tadpole	24 h			2.42					Roundup Ultra-Max	Lajmanovich et al., 2011
<i>Rhinella arenarum</i>	Tadpole	48 h			2.42					Roundup Ultra-Max	Lajmanovich et al., 2011
<i>Rhinella arenarum</i>	Tadpole	6 h			49.65					Infosato	Lajmanovich et al., 2011
<i>Rhinella arenarum</i>	Tadpole	12 h			47.25					Infosato	Lajmanovich et al., 2011
<i>Rhinella arenarum</i>	Tadpole	24 h			38.76					Infosato	Lajmanovich et al., 2011
<i>Rhinella arenarum</i>	Tadpole	48 h			38.76					Infosato	Lajmanovich et al., 2011
<i>Rhinella arenarum</i>	Tadpole	6 h			96.87					Glifoglex	Lajmanovich et al., 2011
<i>Rhinella arenarum</i>	Tadpole	12 h			77.52					Glifoglex	Lajmanovich et al., 2011
<i>Rhinella arenarum</i>	Tadpole	24 h			73.77					Glifoglex	Lajmanovich et al., 2011
<i>Rhinella arenarum</i>	Tadpole	48 h			73.77					Glifoglex	Lajmanovich et al., 2011
<i>Rhinella arenarum</i>	Tadpole	6 h			104.33					C-K YUYOS FAV	Lajmanovich et al., 2011
<i>Rhinella arenarum</i>	Tadpole	12 h			84.06					C-K YUYOS FAV	Lajmanovich et al., 2011
<i>Rhinella arenarum</i>	Tadpole	24 h			77.52					C-K YUYOS FAV	Lajmanovich et al., 2011
<i>Rhinella arenarum</i>	Tadpole	48 h			77.52					C-K YUYOS FAV	Lajmanovich et al., 2011
<i>Scinax nasicus</i>	Tadpole	24 h			1.692					GLYFOS (48% glypkosate as isopropylamine salt)	Lajmanovich et al., 2003

AMPHIBIANS											
Glyphosate											
Species	Life stage	Test duration	LC50			NOEC			LOEC	Formulation	Reference
			(mg a.i L ⁻¹)	(mg RU L ⁻¹)	(mg a.e L ⁻¹)	(mg a.i L ⁻¹)	(mg RU L ⁻¹)	(mg a.e L ⁻¹)	(mg a.e L ⁻¹)		
<i>Scinax nasicus</i>	Tadpole	48 h			1.3032					GLYFOS (48% glypkosate as isopropylamine salt)	Lajmanovich et al., 2003
<i>Scinax nasicus</i>	Tadpole	72 h			1.1628					GLYFOS (48% glypkosate as isopropylamine salt)	Lajmanovich et al., 2003
<i>Scinax nasicus</i>	Tadpole	96 h			0.95					GLYFOS (48% glypkosate as isopropylamine salt)	Lajmanovich et al., 2003
<i>Spea bombifrons</i>	Larvae	48 h			2.03					RoundupWeatherMAX	Dinehart et al., 2010
<i>Spea bombifrons</i>	Larvae	216 h			1.99					RoundupWeatherMAX	Dinehart et al., 2010
<i>Spea bombifrons</i>	Larvae	48 h			1.85					RoundupWeatherMAX	Dinehart et al., 2010
<i>Spea bombifrons</i>	Larvae	216 h			1.65					RoundupWeatherMAX	Dinehart et al., 2010
<i>Spea multiplicata</i>	Larvae	48 h			2.3					RoundupWeatherMAX	Dinehart et al., 2010
<i>Spea multiplicata</i>	Larvae	216 h			1.93					RoundupWeatherMAX	Dinehart et al., 2010
<i>Spea multiplicata</i>	Larvae	48 h			2.11					RoundupWeatherMAX	Dinehart et al., 2010
<i>Spea multiplicata</i>	Larvae	216 h			2.11					RoundupWeatherMAX	Dinehart et al., 2010
<i>Xenopus laevis</i>	Embryo	4 d		72	22.3					Roundup®	Perkins, 1997
<i>Xenopus laevis</i>	Embryo	96 h (pH=6)			15.6					Vision (glyphosate-based herbicide containing a 15% (weight:weight) polyethoxylated tallow amine surfactant blend)	Edginton et al., 2004
<i>Xenopus laevis</i>	Embryo	96 h (pH=7.5)			7.9					Vision (glyphosate-based herbicide containing a 15% (weight:weight) polyethoxylated tallow amine surfactant blend)	Edginton et al., 2004
<i>Xenopus laevis</i>	Larvae	96 h (pH=6)			2.1					Vision (glyphosate-based herbicide containing a 15% (weight:weight) polyethoxylated tallow amine surfactant blend)	Edginton et al., 2004
<i>Xenopus laevis</i>	Larvae	96 h (pH=7.5)			0.88					Vision (glyphosate-based herbicide containing a 15% (weight:weight) polyethoxylated tallow amine surfactant blend)	Edginton et al., 2004

AMPA

No data available

IC50: median inhibitory concentration, EC50: median effective concentration, NOEC: no observed effects concentration, LOEC: lowest observed effect concentration, observed effects concentration, RU: Roundup. Bold value indicates lower NOEC for amphibians.

Table S5: Toxicity of Glyphosate and AMPA to aquatic macrophytes.

AQUATIC MACROPHYTES							
Glyphosate							
Species	Test Duration	IC50 / EC50		NOEC		Formulation	Reference
		(mg RU L ⁻¹)	(mg a.e L ⁻¹)	(mg RU L ⁻¹)	(mg a.e L ⁻¹)		
<i>Lemna gibba</i>	7 d	15,1	4,7			Roundup®	Perkins, 1997
<i>Lemna gibba</i>	7 d		10			Glyphosate	Perkins, 1997
<i>Lemna gibba</i>	14 d		25,5		16,6	Glyphosate	Malcolm Pirnie, 1987d
<i>Lemna minor</i>	14 d	4,9	1,5			Roundup®	Hartman and Martin, 1984
<i>Lemna minor</i>	14 d			56	17,4	Roundup®	Lockhart et al., 1989
<i>Myriophyllum sibiricum</i>	14 d	3,9	1,2			Roundup®	Perkins, 1997
<i>Myriophyllum sibiricum</i>	14 d		1,6			Glyphosate	Perkins, 1997
<i>Potamogeton pectinatus</i>	14 d			24	7,4	Roundup®	Hartman and Martin, 1985
AMPA							
No data available							

LC50: median lethal concentration, EC50: median effective concentration, NOEC: no observed effects concentration, RU: Roundup. Bold value indicates lower NOEC for aquatic macrophytes.

Table S6: Toxicity of Glyphosate to benthic organisms.

BENTHIC ORGANISMS									
Glyphosate									
Species	Test duration	EC50/LC50			NOEC			Formulation	Reference
		(mg a.i L ⁻¹)	(mg RU L ⁻¹)	(mg a.e L ⁻¹)	(mg a.i L ⁻¹)	(mg RU L ⁻¹)	(mg a.e L ⁻¹)		
<i>Chironomus plumosus</i>	2 d		58,1	18,0				Roundup®	Folmar et al., 1979
<i>Chironomus plumosus</i>	2 d	55		41				Glyphosate (tested as IPA salt)	Folmar et al., 1979
<i>Chironomus riparius</i>	2 d	5600		4200				Glyphosate (tested as IPA salt)	Buhl and Faerber, 1989
<i>Chironomus tentansd</i>	10 d	>530		398	265		199	Glyphosate (tested as IPA salt)	Beyers, 1993
<i>Tubifex tubifex</i>	28 d					>89	> 28	Roundup®	Perkins, 1997

LC50: median lethal concentration, EC50: median effective concentration, NOEC: no observed effects concentration, RU: Roundup. Bold value indicates lower NOEC for aquatic benthic organisms.

References of Supplementary material.

- ABC Inc. (1978a) Acute toxicity of technical glyphosate to *Daphnia magna*. Monsanto unpublished study AB-78-201. Analytical Biochemistry Laboratories, Inc., Columbia, MO. (Cited in Giesy et al. 2000).
- ABC Inc. (1978b) Acute toxicity of technical glyphosate to rainbow trout (*Salmo gairdnerii*). Monsanto unpublished study AB-78-165. Analytical Biochemistry Laboratories, Inc., Columbia, MO. (Cited in Giesy et al. 2000).
- ABC Inc. (1978c) Acute toxicity of technical glyphosate to bluegill sunfish (*Lepomis macrochirus*). Monsanto unpublished study AB-78-123. Analytical Biochemistry Laboratories, Inc., Columbia, MO. (Cited in Giesy et al. 2000).
- ABC Inc. (1981a) Acute toxicity of MON 0139 to *Daphnia magna*. Monsanto unpublished study AB-81-074. Analytical Biochemistry Laboratories, Inc., Columbia, MO. (Cited in Giesy et al. 2000).
- ABC Inc. (1981b) Acute toxicity of MON 0139 to bluegill sunfish (*Lepomis macrochirus*). Monsanto unpublished study AB-81-073. Analytical Biochemistry Laboratories, Inc., Columbia, MO. (Cited in Giesy et al. 2000).
- ABC Inc. (1981c) Acute toxicity of MON 0139 to rainbow trout (*Salmo gairdneri*). Monsanto unpublished study AB-81-072. Analytical Biochemistry Laboratories, Inc., Columbia, MO. (Cited in Giesy et al. 2000).
- ABC Inc. (1982a) Dynamic 96-hour acute toxicity of Roundup to bluegill sunfish (*Lepomis macrochirus*). Monsanto unpublished study AB-82-33. Analytical Biochemistry Laboratories, Inc., Columbia, MO. (Cited in Giesy et al. 2000).
- ABC Inc. (1982b) Dynamic 48-hour acute toxicity of Roundup to *Gammarus pseudominaeus*. Monsanto unpublished study AB-82-035. Analytical Biochemistry Laboratories, Inc., Columbia, MO. (Cited in Giesy et al. 2000).

ABC Inc. (1982c) Dynamic 96-hour acute toxicity of Roundup to rainbow trout (*Salmo gairdnerii*). Monsanto unpublished study AB-82-034. Analytical Biochemistry Laboratories, Inc., Columbia, MO. (Cited in Giesy et al. 2000).

ABC Inc. (1982d) Chronic toxicity of glyphosate to *Daphnia magna* under flow-through test conditions. Monsanto unpublished study AB-82-036. Analytical Biochemistry Laboratories, Inc., Columbia, MO. (Cited in Giesy et al. 2000).

ABC Inc. (1989a) Flow-through toxicity of glyphosate to rainbow trout (*Salmo gairdnerii*) for a 21 day duration period. Monsanto unpublished study AB-89-036. Analytical Biochemistry Laboratories, Inc., Columbia, MO. (Cited in Giesy et al. 2000).

ABC Inc. (1989b) 21 Day prolonged static renewal toxicity of Roundup to *Daphnia magna*. Monsanto unpublished study AB-89-059. Analytical Biochemistry Laboratories, Inc., Columbia, MO. (Cited in Giesy et al. 2000).

ABC Inc. (1989c) 21 Day prolonged static renewal toxicity of glyphosate technical to *Daphnia magna*. Monsanto unpublished study AB-89-058. Analytical Biochemistry Laboratories, Inc., Columbia, MO. (Cited in Giesy et al. 2000).

ABC Inc. (1989d) Flow-through toxicity of Roundup to rainbow trout (*Salmo gairdnerii*) for a 21 day exposure period. Monsanto unpublished study AB-89-037. Analytical Biochemistry Laboratories, Inc., Columbia, MO. (Cited in Giesy et al. 2000).

ABC Inc. (1991a) Acute toxicity of AMPA to *Daphnia magna*. Monsanto unpublished study AB-90-401. Analytical Biochemistry Laboratories, Inc., Columbia, MO. (Cited in Giesy et al. 2000).

ABC Inc. (1991b) Acute toxicity of AMPA to rainbow trout (*Oncorhynchus mykiss*). Monsanto unpublished study AB-90-402. Analytical Biochemistry Laboratories, Inc., Columbia, MO. (Cited in Giesy et al. 2000).

Beyers DW (1993) Acute toxicity of Rodea and Valent X-77 to Rio Grande silvery minnow as estimated by surrogate species: Plains minnow, fathead minnow, *Hyaella azteca*, and *Chironomus tentans*. US Bureau of Reclamation, Upper Colorado Regional office, Final Report, Feb 12 (Cited in Giesy et al. 2000).

- Beyers DW (1995) Acute toxicity of Rodeo® herbicide to Rio Grande silvery minnow as estimated by surrogate species: plains minnow and fathead minnow. *Arch Environ Contam Toxicol* 29:24-26.
- Bidwell JR, Gorrie JR (1995) Acute toxicity of a herbicide to selected frog species. Final report. Prepared for Western Australian Department of Environmental Protection, Westralia Square, 141 St. George's Terrace, Perth, 6000, Australia.
- Bionomics (1973) Acute toxicity of Roundup to bluegill (*Lepomis macrochirus*). Monsanto unpublished study BN-73-078. Bionomics, Wareham, MS. (Cited in Giesy et al. 2000).
- Bonnet JL, Bonnemoy F, Dusser M, Bohatier J (2007) Assessment of the potential toxicity of herbicides and their degradation products to nontarget cells using two microorganisms, the bacteria *Vibrio fischeri* and the ciliate *Tetrahymena pyriformis*. *Environ. Toxicol.* 22(1):78–91.
- Bozeman J, Koopman B, Bitton G (1989) Toxicity testing using immobilized algae. *Aquat Toxicol* 14(4):345-352.
- Bringolf RB, Cope WG, Mosher S, Barnhart MC, Shea D (2007) Acute and chronic toxicity of glyphosate compounds to glochidia and juveniles of *Lampsilis siliquoidea* (Unionidae). *Environ. Toxicol. Chem.* 26(10):2094–2100.
- Buhl KJ, Faerber NL (1989) Acute toxicities of selected herbicides and surfactants to larvae of the midge *Chironomus riparius*. *Arch Environ Contam Toxicol* 18:530-536.
- Christian FA, Jackson RN, Tate TM (1993) Effect of sublethal concentrations of glyphosate and dalapon on protein and aminotransferase activity in *Pseudosuccinea columella*. *Bull Environ Contam Toxicol* 51:703-709.
- Christy SL, Karlander EP, Parochetti IV (1981) Effects of glyphosate on the growth rate of *Chlorella*. *Weed Sci* 29(1):5-7.
- Dengler D, Mende P (1994a) Testing of toxic effects of aminomethyl phosphonic acid (AMPA) on the single cell green alga (*Scenedesmus subspicatus*). Unpublished study XX-93-271. Monsanto Company, St. Louis, MO. (Cited in Giesy et al. 2000).

- Dengler D, Mende P (1994b) Testing of toxic effects of the isopropylamine salt of glyphosate acid on the single cell green alga *Scenedesmus subspicatus*. Unpublished study XX-93-270. Monsanto Company, St. Louis, MO. (Cited in Giesy et al. 2000).
- Dinehart SK, Smith LM, McMurry ST, Smith PN, Anderson TA, Haukos DA (2010) Acute and chronic toxicity of Roundup Weathermax (®) and Ignite (®) 280 sl to larval *Spea multiplicata* and *S. bombifrons* from the Southern high plains, USA. *Environ. Pollut.* 158(8):2610–2617.
- Edginton AN, Sheridan PM, Stephenson GR, Thompson DG, Boermans HJ (2004) Comparative effects of pH and Vision (®) herbicide on two life stages of four anuran amphibian species. *Environ. Toxicol. Chem.* 23(4):815–822.
- EG & G Bionomics (1975) Chronic toxicity of glyphosate to the fathead minnow (*Pimephales promelas* Rafinesque). Monsanto unpublished study BN-75-129. EG & G Bionomics, Aquatic Toxicology Laboratory, Wareham, MS. (Cited in Giesy et al. 2000).
- EG & G Bionomics (1978) Toxicity of seven test materials to sheepshead minnows, (*Cyprinodon variegatus*). Monsanto unpublished study BN-78-44B. EG & G Bionomics, Marine Research Laboratory, Pensacola, FL. (Cited in Giesy et al. 2000).
- EG & G Bionomics (1980a) Acute toxicity of Roundup to channel catfish (*Ictalurus punctatus*). Monsanto unpublished study BN-80-076. EG & G Bionomics, Aquatic Toxicology Laboratory, Wareham, MS. (Cited in Giesy et al. 2000).
- EG & G Bionomics (1980b) Acute toxicity of Roundup to bluegill (*Lepomis macrochirus*). Monsanto unpublished study BN-80-075. EG & G Bionomics, Aquatic Toxicology Laboratory, Wareham, MS. (Cited in Giesy et al. 2000).
- EG & G Bionomics (1980c) Acute toxicity of Roundup to the rainbow trout (*Salmo gairdnerii*). Monsanto unpublished study BN-80-074. EG & G Bionomics, Aquatic Toxicology Laboratory, Wareham, MS. (Cited in Giesy et al. 2000).
- EG & G Bionomics (1980d) Acute toxicity of Roundup to the fathead minnow (*Pimephales promelas*). Monsanto unpublished study BN-80-077. EG & G Bionomics, Aquatic Toxicology Laboratory, Wareham, MS. (Cited in Giesy et al. 2000).

- EG & G Bionomics (1980e) Acute toxicity of Roundup to the water flea (*Daphnia magna*). Monsanto unpublished report BN-80-079. EG & G Bionomics, Aquatic Toxicology Laboratory, Wareham, MS. (Cited in Giesy et al. 2000).
- EG & G Bionomics (1980f) Acute toxicity of Roundup to the water flea (*Daphnia magna*) with and without continuous aeration. Monsanto unpublished study BN-80- 181. EG & G Bionomics, Aquatic Toxicology Laboratory, Wareham, MS. (Cited in Giesy et al. 2000).
- EG & G Bionomics (1980g) Acute toxicity of Roundup to the rainbow trout (*Salmo gairdnerii*) with continuous aeration and without aeration. Monsanto unpublished study BN-80-180. EG & G Bionomics, Aquatic Toxicology Laboratory, Wareham, MS. (Cited in Giesy et al. 2000).
- Folmar LC, Sanders HO, Julin AM (1979) Toxicity of the herbicide glyphosate and several of its formulations to fish and aquatic invertebrates. *Arch. Environ. Contam. Toxicol.* 8(3):269–278.
- Fuentes L, Moore LJ, Rodgers JH, Bowerman WW, Yarrow GK, Chao WY (2011) Comparative toxicity of two glyphosate formulations (original formulation of Roundup (®) and Roundup Weathermax (®) to six north american larval anurans. *Environ. Toxicol. Chem.* 30(12):2756–2761.
- Gardner SC, Grue CE, Grassley JM, Lenz LA, Lindenauer JM, Seeley ME (1997) Single species algal (*Ankistrodesmus*) toxicity tests with Rodeo and Garlon 3A. *Bull Environ Contam Toxicol* 59:492-499.
- Giesy JP, Dobson S, Solomon KR (2000) Ecotoxicological risk assessment for Roundup herbicide. *Rev Environ Contam Toxicol* 167:35–120
- Hartman WA, Martin DB (1984) Effect of suspended bentonite clay on the acute toxicity of glyphosate to *Daphnia pulex* and *Lemna minor*. *Bull Environ Contam Toxicol* 33(3):355-361.
- Hartman W A, Martin DB (1985) Effects of four agricultural pesticides on *Daphnia pulex*, *Lemna minor*, and *Potamogeton pectinatus*. *Bull Environ Contam Toxicol* 35(5): 646-651.

- Hernando F, Royuela M, Munoz-Rueda A, Gonzalez-Murua C (1989) Effects of glyphosate on the greening process and photosynthetic metabolism in *Chlorella pyrenoidosa*. *J Plant Physiol* 134:26-31.
- Hess FD (1980) A *Chlamydomonas* algal bioassay for detecting growth inhibitor herbicides. *Weed Sci* 28(5):515-520.
- Hildebrand LD, Sullivan DS, Sullivan TP (1982) Experimental studies of rainbow trout populations exposed to field applications of Roundup herbicide. *Arch Environ Contam Toxicol* 11:93-98.
- Holck AR, Meek CL (1987) Dose-mortality responses of crawfish and mosquitoes to selected pesticides. *J Amer Mosquito Control Assoc* 3(3):407-411.
- Holdway DA, Dixon DG (1988) Acute toxicity of permethrin or glyphosate pulse exposure to larval white sucker (*Catostomus commersoni*) and juvenile flagfish (*Jordanella floridae*) as modified by age and ration level. *Environ Toxicol Chem* 7:63-68.
- Howe CM, Berrill M, Pauli BD, Helbing CC, Werry K, Veldhoen N (2004) Toxicity of glyphosate-based pesticides to four North American frog species. *Environ. Toxicol. Chem.* 23(8):1928–1938.
- HRC (1977) The acute toxicity of glyphosate to harlequin fish (*Rasbora heteromorpha*). Monsanto unpublished study HU-77-465. Huntingdon Research Centre, Huntingdon, UK. (Cited in Giesy et al. 2000).
- Hued AC, Oberhofer S, Bistoni MD (2012) Exposure to a commercial glyphosate formulation (Roundup®) alters normal gill and liver histology and affects male sexual activity of *Jenynsia multidentata* (Anablepidae, Cyprinodontiformes). *Arch. Environ. Contam. Toxicol.* 62(1):107–117.
- Kreutz LC, Barcellos LJG, Silva TO, Anziliero D, Martins D, Lorenson M, Marteninghe A, Da Silva LB (2008) Acute toxicity test of agricultural pesticides on silver catfish (*Rhamdia quelen*) fingerlings. *Ciencia Rural* 38(4):1050–1055.

- Lajmanovich RC, Sandoval MT, Peltzer PM (2003) Induction of mortality and malformation in *Scinax nasicus* tadpoles exposed to glyphosate formulations. *Bull. Environ. Contam. Toxicol.* 70: 612–618.
- Lajmanovich RC, Attademo AM, Peltzer PM, Junges CM, Cabagna MC (2011) Toxicity of four herbicide formulations with glyphosate on *Rhinella arenarum* (Anura: Bufonidae) tadpoles: B-esterases and glutathione s-transferase inhibitors. *Arch. Environ. Contam. Toxicol.* 60:681–689.
- Langiano VC, Martinez CBR (2008) Toxicity and effects of a glyphosatebased herbicide on the neotropical fish *Prochilodus lineatus*. *Comp. Biochem. Physiol. C: Toxicol. Pharmacol.* 147:222–231.
- Liong PC, Hamzah WP, Murugan V (1988) Toxicity of some pesticides towards freshwater fishes. *Malays Agric J* 54(3):147-156.
- LISEC (1989) Alga, growth inhibition test. Effect of MON 2139 on the growth of *Selenastrum capricornutum*. Monsanto unpublished study XX-89-093. LISEC, Study Centre for Ecology and Forestry, Bokrijk, Belgium. (Cited in Giesy et al. 2000).
- Lockhart WL, Billeck BN, Baron CL (1989) Bioassays with a floating aquatic plant (*Lemna minor*) for effects of sprayed and dissolved glyphosate. *Hydrobiologia* 188/ 189:353-359.
- Ma J (2002) Differential sensitivity to 30 herbicides among populations of two green algae *Scenedesmus obliquus* and *Chlorella pyrenoidosa*. *Bull. Environ. Contam. Toxicol.* 68:275–281.
- Malcolm Pirnie (1987a) The toxicity of glyphosate technical to *Anabaena flos-aquae*. Monsanto unpublished study XX-88-415. Malcolm Pimie Inc., White Plains, NY. (Cited in Giesy et al. 2000).
- Malcolm Pirnie (1987b) The toxicity of glyphosate technical to *Skeletonema costatum*. Monsanto unpublished study XX-88-414. Malcolm Pimie Inc., White Plains, NY. (Cited in Giesy et al. 2000).

Malcolm Pirnie (1987c) The toxicity of glyphosate technical to *Navicula pelliculosa*. Monsanto unpublished study XX-88-413. Malcolm Pimie Inc., White Plains, NY. (Cited in Giesy et al. 2000).

Malcolm Pirnie (1987d) The toxicity of glyphosate technical to *Lemna gibba*. Monsanto unpublished study XX-88-416. Malcolm Pimie Inc., White Plains, NY. (Cited in Giesy et al. 2000).

Mann RM, Bidwell JR (1999) The toxicity of glyphosate and several glyphosate formulations to four species of southwestern Australian frogs. *Arch Environ Con tam Toxicol* 36:193-199.

Maule A, Wright SJL (1984) Herbicide effects on the populations growth of some green algae and cyanobacteria. *J Appl Bacteriol* 57:369-379.

Mayer FL, Ellersieck MR (1986) Manual of acute toxicity: interpretation and data base for 410 chemicals and 66 species of freshwater animals. United States Department of the Interior, Fish and Wildlife Service Resource Publication 160. Washington, DC.

Mitchell DG, Chapman PM, Long TJ (1987) Acute toxicity of Roundup and Rodeo herbicides to rainbow trout, chinook, and coho salmon. *Bull Environ Con tam Toxicol* 39(6): 1028-1035.

Moore LJ, Fuentes L, Rodgers JH Jr, Bowerman WW, Yarrow GK, Chao WY, Bridges WC, Jr (2012) Relative toxicity of the components of the original formulation of Roundup® to five north american anurans. *Ecotoxicol. Environ. Saf.* 78:128–133.

Morgan JD, Vigers GA, Farrell AP, Janz DM, Manville JF (1991) Acute avoidance reactions and behavioral responses of juvenile rainbow trout (*Oncorhynchus mykiss*) to Garlon 4, Garlon 3^a and Vision herbicides. *Environ Toxicol Chern* 10:73-79.

Morgan MJ, Kiceniuk JW (1992) Response of rainbow trout to a two month exposure to Vision, a glyphosate herbicide. *Bull Environ Contam Toxicol* 48:772-780.

NATEC (1990) Glyphosate: growth inhibition test with algae according to OECD-guideline 201. Monsanto unpublished study XX-90-523. Study NA89 9654. NATEC Institut fur Naturwissenschaftlich Technische Dienste GmbH, Hamburg, Germany. (Cited in Giesy et al. 2000).

- Perkins MJ (1997) Effects of two formulations of glyphosate and triclopyr on four nontarget aquatic species: *Xenopus laevis*, *Myriophyllum sibiricum*, *Lemna gibba*, and *Tubifex tubifex*. M.Sc. thesis. University of Guelph, Guelph, Ontario, Canada.
- Relyea RA (2005) The lethal impacts of Roundup and predatory stress on six species of North American tadpoles. *Arch. Environ. Contam. Toxicol.* 48(3):351–357.
- Relyea RA, Jones DK (2009) The toxicity of Roundup OriginalMax® to 13 species of larval amphibians. *Environ. Toxicol. Chem.* 28(9):2004–2008.
- Saenz ME, Di Marzio WD, Alberdi JL, del Carmen Tortorelli M (1997) Effects of technical grade and a commercial formulation of glyphosate on algal population growth. *Bull Environ Contam Toxicol* 59(4):638-644.
- Servizi JA, Gordon RW, Marten DW (1987) Acute toxicity of Garlon 4 and Roundup herbicides to salmon, *Daphnia*, and trout. *Bull Environ Contam Toxicol* 39(1):15-22.
- Sun F (1987) Evaluating acute toxicity of pesticides to aquatic organisms carp, mosquitofish and daphnids. *Plant Prot Bull* 29(4):385-396.
- Thomas MW, Judy BM, Lower WR, Krause GF, Sutton WW (1990) Time-dependent toxicity assessment of herbicide contaminated soil using the green alga *Selenastrum capricornutum*. In: Wand W, Gorusch JW, Lower WR (eds) *Plants for Toxicity Assessment*. ASTM STP 1091. American Society for Testing and Materials, Philadelphia, p 235.
- Thompson J (1989) Chronic effects of sub-lethal levels of dalapon, glyphosate, and 2,4- D amine on the lymnaeid snails *Pseudosuccinea columella* and *Fossaria cubensis*. M.S. thesis, Southern University Library, Baton Rouge, LA. (Cited in Christian et al. 1993).
- Tooby TE, Lucey J, Stott B (1980) The tolerance of grass carp, *Ctenopharyngodon idella* Val., to aquatic herbicides. *J Fish Biol* 16:591-597.
- Tsui MTK, Chu LM (2003) Aquatic toxicity of glyphosate-based formulations: Comparison between different organisms and the effects of environmental factors. *Chemosphere* 52(7):1189–1197.

- Vendrell E, de Barreda Ferraz DG, Sabater C, Carrasco JM (2009) Effect of glyphosate on growth of four freshwater species of phytoplankton: A microplate bioassay. *Bull. Environ. Contam. Toxicol.* 82(5):538–542.
- Wan MT, Watts RG, Moul OJ (1989) Effects of different dilution water types on the acute toxicity to juvenile Pacific salmonids and rainbow trout of glyphosate and its formulated products. *Bull Environ Contam Toxicol* 43(3):378-385.
- WHO (World Health Organization) (1994) Glyphosate: environmental health criteria 159. World Health Organization, Geneva, Switzerland.
- Wojtaszek BF, Staznik B, Chartrand DT, Stephenson GR, Thompson DG (2004) Effects of Vision® herbicide on mortality, avoidance response, and growth of amphibian larvae in two forest wetlands. *Environ. Toxicol. Chem.* 23(4):832–842.