Toxicity Related to Current-Use Pesticides

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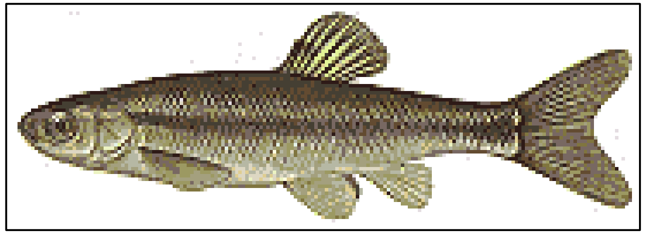
Aquatic Toxicity

Aquatic toxicity is the aggregate toxic effect of a sample measured directly by an aquatic toxicity test.

Aquatic toxicity tests measure biological effects (e.g., survival, growth, reproduction, development).

Acute versus Chronic.



fathead minnow

water flea

amphipod crustacean

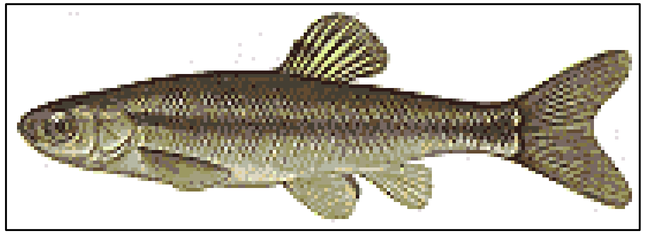
midge fly larva

Solubility & Persistence of Representative Insecticides

Chemical	Log K_{ow}	K_{oc} (mL/g)	Soil Half Life (aerobic)	Water Half Life (photolysis)	Water Half Life (hydrolysis)
DDT	6.0	2,000,000	2 – 15 Years	Weeks – Years	Weeks – Years
Chlorpyrifos	4.7	6,070	7 – 120 Days	21 – 28 Days	35 – 78 Days
Bifenthrin	6.0	240,000	3 – 8 Months	9 – 14 Months	Months – Years
Imidacloprid	0.6	132 - 400	104 – 228 Days	<3 Hours	33 – 44 Days

Insecticide History

Changing Use of Insecticides							
1950	1960	1970	1980	1990	2000	2010	2020
Organochlorines (e.g., DDT)							
		Organophosphates (e.g., Chlorpyrifos)					
			Pyrethroids (e.g., Bifenthrin)				
				Phenylpyrazoles (e.g., Fipronil)			
					Neonicotinoids (Imidacloprid)		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Comparative Toxicity

Pesticide 96-Hour LC50 (ng/L)	Chlorpyrifos	Bifenthrin	Fipronil	Imidacloprid
Fathead Minnow	122,000	4,850	398,290	?
Water Flea	54	142	17,700	2,070*
Amphipod	86	9.3	728	65,430
Midge Fly Larva	290	69	32.5	2,650

* 48-Hour LC50 .

Imidacloprid Toxicity

Endpoint	Conc. (ng/L)	Reference
C. Dilutus 96-Hour LC50	2,650	Stoughton et al. 2008
C. Dilutus 14-Day LC50	1,520	Cavallero et al. 2017
C. Dilutus 28-Day LC50	910	Stoughton et al. 2008
C. Dilutus 40-Day Emergence EC50	390	Cavallero et al. 2017
U.S. EPA Acute Benchmark	385	www.epa.gov/pesticide-science-and-assessing-pesticide-risks/aquatic-life-benchmarks-and-ecological-risk
Acute Neonicotinoid Protection	200	Morrissey et al. 2015
Chronic Neonicotinoid Protection	35	Morrissey et al. 2015
U.S. EPA Chronic Benchmark	10	www.epa.gov/pesticide-science-and-assessing-pesticide-risks/aquatic-life-benchmarks-and-ecological-risk

Toxicity and Current-Use Insecticides (DPR and Region 3 - 2014)

Station	***Hyalella* (10-day)** Survival (%)	Pyrethroid (TU)	Imidacloprid (TU)	***Chironomus* (10-day)** Survival (%)	Pyrethroid (TU)	Imidacloprid (TU)
Alisal Slough	38	0.52	0.02	0	0.14	0.50
Chualar Creek	0	2.29	0.03	73	0.67	0.66
Main St. Ditch	94	0	0.02	92	0	0.52
Orcutt Creek	50	0.78	0.02	48	0.01	0.58
Oso Flaco Creek	0	4.11	0.01	42	0.25	0.22
Quail Creek	0	5.99	0.01	2	1.09	0.35
Rec Ditch III	30	2.48	0.03	4	0.20	0.76
Solomon Creek	98	0	0.14	0	0	3.45
Tembladero Sl.	59	0.42	0.00	83	0.14	0.06

Anderson et al. 2018

Other Collaborative Monitoring (Orcutt Creek 5/16-9/16)

Date	Toxicity (% Survival)			Chemistry (ng/L)		
	Hyalella (96-Hour)	*Chironomus* (10-Day)	*Ceriodaphnia* (96-Hour)	Imidacloprid	Malathion	Pyrethroids
May-16	96	8	NA	1010	ND	ND
Jun-16	100	63	NA	No Chem	No Chem	No Chem
Sep-16	100	0	72	1560	62	ND

Unpublished but in SWAMP Database

Other Collaborative Monitoring (Monterey County 4/17-5/17)

Apr-17	*Hyalella* (96-Hour) % Survival	*Chironomus* (10-Day) % Survival	Imidacloprid ng/L	Pyrethroids ng/L	Organophosphates ng/L
309DAV	100	94	23	ND	ND
309TEH	8	96	128	32	Trace
May-17					
309DAV	96	NA	Trace	ND	ND
309TEH	90	NA	135	9.5	106 (Malathion)

Unpublished but in SWAMP Database

Other Collaborative Monitoring (Region 3 10/17-1/18)

	Hyalella (96-Hour)	*Chironomus* (10-Day)		*Ceriodaphnia* (96-Hour)
Oct-17	% Survival	% Survival	Growth	% Survival
309ALD	98	85	1.44	96
309HRT	28	0	-	100
315CARNRR	100	71	1.01	96
315FRC	90	96	2.45	0
Jan-18				
304SLRWAT	100	96	2.24	100
309ALD	100	96	4.02	100
309HRT	12	96	0.92	96
309TEM	78	98	2.82	100
310SLV	98	96	3.43	100
312BCU	56	42	0.12	92
315MIS	98	92	2.66	100

Unpublished but in SWAMP Database

Summary

- Insecticide use continues to change, and the focus of monitoring should be on current-use active ingredients.
  - Evolving monitoring programs will always have species that can detect new chemicals.
- Management practices are informed and should be consistently updated.
  - Sedimentation for pyrethroids or granulated activated carbon for more soluble chemicals.