CASE GS0315 LINDANE PM PM# 04/05/84

CHEM 009001 Lindane (gamma isomer of benzene hexac

BRANCH EEB DISC 40 TOPIC 05054547

FORMULATION 00 - ACTIVE INGREDIENT

FICHE/MASTER ID 05017538 CONTENT CAT 01

Sanders, H.O. (1972) Toxicity of Some Insecticides to Four Species of Malacostracan Crustaceans. Washington, D.C.: U.S. Department of the Interior, Fish and Wildlife Service. (U.S. Bureau of Sport Fisheries and Wildlife technical paper no. 66)

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DATA EVALUATION RECORD

CHEMICAL: See tables

FORMULATION: Technical Grades

CITATION: MRID 05017538. Sanders, H.O. (1972) Toxicity of some insecticides to four species of malocostracan crustaceans. Washington, D.C: U.S. Department of the Interior, Fish and Wildlife Service. (U.S. Bureau of Sport Fisheries and Wildlife Technical Paper No. 66).

REVIEWED BY: Ann Stavola
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DATE REVIEWED: May 23, 1983

TEST TYPE: Static and intermittent flow aquatic toxicity tests
Gammarus fasciatus (scud)
Palaemonetes kadiakensis (glass shrimp)
Orconectes nais (Crayfish)
Asellus brevicaudus (Sowbug)

REPORTED RESULTS: See tables

REVIEWER'S CONCLUSIONS: The studies are scientifically sound but do not meet our guideline requirements for freshwater invertebrate testing. The results indicate that lindane, 99% ai, is very highly toxic to *Gammarus faxciatus* and *Asellus brevicaudus*. The respective 96-hr LC50 values were 10 (7-14) ppb and 10 (7-14) ppb.

Materials and Methods
Test Procedures

The organisms used in this study were the scud, Gammarus fasciatus, the sowbug, Asellus brevicaudus, the glass shrimp, Palaemonetes kadiakensis, and the crayfish Onconectes nais. The animals were collected from local FW streams and ponds and kept in an indoor simulated stream prior to acclimation in the test aquaria.

Short-term acute toxicity tests were conducted according to the methods of Sanders' paper, "Toxicity of Pesticides to the Crustaceans, Gammarus lacustris", MRID 00097842. The long-term studies were conducted with an intermittent-flow proportional diluter.

Most of the tests were conducted with soft-quality reconstituted water, while some were conducted with hard-quality well water. The static tests were conducted at 21°C and the intermittent-flow tests at 18-21°C. There were duplicate test vessels containing 10 organisms each per concentration. In the tests with large crayfish, there was only one animal per container and 10 containers per replicate. Controls were used for each tests.

Statistical Analysis

A modification of the Litchfield-Wilcoxon method was used to calculate the TL_{50} values and confidence limits. The concentrations and observed percent mortalities were converted to logs and probits, respectively, and a linear regression equation was calculated.

Results and Discussion
Scuds (Tables 2 to 5)

Organophosphates are generally more toxic than organo chlorines to scuds. Some insecticides were slightly more toxic in raw water, but in most cases the differences were not statistically significant. Table 5 gives a comparison of toxicity under static and flow-through conditions.

Glass Shrimp (Tables 6 to 8)

The results are for testing done with late-instar glass shrimp using raw water. Table 7 compares toxicities for several pesticides under static and flow-through conditions, and table 8 gives the results for long-term studies for azinphosmethyl, zectran and fenthion.

Crayfish

The toxicity data for mature crayfish are listed in table 9. Effects of age on toxicity were studied with DDT (table 10) and several insecticides (table 11). Toxicity decreases as the animals become older.

Aquatic Sowbug

Toxicity values are listed in table 12. Generally organochlorine insecticides were more toxic than the organophosphates.

Summary of Results

Among the 4 species of crustaceans, scud was generally the most sensitive to insecticides, followed by glass shrimp, sowbug and crayfish. Malathion was the least toxic insecticide tested to 3 of the 4 species of crustacea.

Reviewer's Evaluation
Materials and Methods
Test Procedures

Immature crustaceans, in an early instar stage, should be tested. With the exception of the tests conducted with young crayfish, the test organisms were too mature. Sowbugs are not a recommended invertebrate species. Additionally, the water quality for each test was not indicated.

Statistical Analysis

The method used is acceptable; however, the results cannot be verified without the raw data.

Results and Discussion

The differences in species response and differences in toxicity among the various insecticides are important factors.

Conclusions

Category: Supplemental

Rationale: Use of mature organisms instead of immature organisms preclude any of the tests, except those on immature crayfish, from being core studies. Additionally the water chemistry data and raw data were omitted.

Repairability: If the missing data are submitted, only the studies done with immature crayfish may be upgraded to core.

Table 2.--Toxicity values of various technical grade insecticides for scud, *Gammarus fasciatus*, calculated from static bioassays conducted in reconstituted water at 21° C.

Insecticide	TL50 values 1/ in micrograms per liter at 24 hours		at 96 hours	
Organochlorines				
TDE (DDD)	4.6	(3.6-5.8)	0.60	(0.05-1.2)
Methoxychlor	5.6	(3.2-7.6)	1.9	(1.2-3.1)
DDT	15	(9.0-20)	3.2	(1.8-5.6)
Endrin	1C	(9.0-36)	4.3	(3.5-5.2)
Lindane	32	(22-43)	10	(7-14)
Toxaphene	82	(70-98)	35	(20-55)
Chlordane	100	(60-190)	40	(21-60)
Heptachlor	180	(130-260)	56	(33-78)
Dieldrin	1,800	(1,300-2,500)	640	(460-880)
Aldrin	56,000	(42,400-73,900)	4,300	(3,500-5,300)
Methylcarbamates				
Carbaryl	50	(32-70)	26	(16-39)
Baygon (R)	68	(56-82)	50	(32-74)
Zectran (R)	80	(60-120)	40	(20-60)
Botanicals				
Pyrethrum	31	(20-50)	11	(8-15)
Allethrin	40	(28-62)	8	(5-12)

1/ 95-percent confidence limits in parentheses.

The toxicity of some insecticides may be dependent upon such water quality parameters as pH, alkalinity, and hardness. The bioassays were made simultaneously in raw and reconstituted water (table 4). Some insecticides were slightly more toxic in raw water, but in most cases the differences in observed toxicities were not statistically significant.

The TL50 values for 5-day exposures to malathion were similar in static and intermittent-flow tests conducted simultaneously (table 5). Scud exposed in the intermittent-flow system appeared more resistant to DDT, parathion, and endrin than specimens exposed in the static system. Jensen and Gaufin (1964) reported that stonefly naiads, *Pteronarcys californica* Newport, exposed for 4 days in a continuous-flow system, resisted DDT solutions

Table 3.--Toxicity values of various technical grade organophosphate insecticides for scud, *Gammarus fasciatus*, calculated from static bioassays conducted in reconstituted water at 21° C.

Insecticide	TL50 values 1/ in micrograms per liter at 24 hours		at 96 hours	
Coumaphos	0.56	(0.39-0.81)	0.15	(0.11-0.20)
Dichlorovos	1.8	(1.3-2.4)	0.40	(0.32-0.49)
Azinphosmethyl	2.0	(1.6-2.7)	0.38	(0.24-0.59)
Parathion	3.2	(2.0-7.0)	1.3	(0.60-1.9)
Malathion	3.8	(2.7-5.3)	0.76	(0.63-0.92)
Phorate	4.7	(2.6-6.8)	0.68	(0.36-1.0)
Imidan (R)	5.0	(4.0-6.0)	2.0	(1.4-2.8)
Dursban (R)	5.6	(3.2-8.1)	0.32	(0.12-0.90)
Endosulfan	10	(7.0-14)	6.0	(4.0-8)
Ethion	18	(12-26)	9.4	(7.0-14)
Mevinphos	19	(17-22)	3.5	(3.1-3.9)
Dioxathion	24	(20-29)	8.6	(5.4-14)
Naled	32	(20-51)	14	(11-18)
EPN	45	(35-58)	6.8	(3.8-13)
Ciodrin (R)	50	(33-75)	11	(8.0-15)
Phosphamidon	86	(75-95)	16	(10-26)
Disulfoton	110	(70-160)	27	(24-30)
Fenthion	220	(140-300)	110	(80-150)
Tepp	250	(170-340)	210	(150-280)
Demeton	500	(260-710)	27	(20-36)
Azodrin (R)	1,000	(760-1,300)	160	(120-280)
VC-13 (R)	1,200	(540-1,850)	110	(80-150)
Oxydemetonmethyl	2,100	(1,700-2,500)	1,000	(980-1,100)
Bidrin (R)	5,600	(5,000-7,200)	2,600	(2,100-3,200)
Rulene (R)	5,700	(4,900-6,400)	3,700	(3,400-4,100)

1/ 95 percent confidence limits in parentheses.

Table 4.--Toxicity values of various technical grade insecticides for scud, *Gammarus fasciatus*, calculated from static bioassays conducted in raw water at 21° C.

Insecticide	TL50 values 1/ in micrograms per liter at 24 hours		at 96 hours	
Azinphosmethyl	0.44	(0.26-0.75)	0.10	(0.073-0.14)
Malathion	3.2	(2.0-5.1)	0.90	(0.64-1.3)
TDE (DDD)	3.2	(2.1-4.3)	0.86	(0.42-1.3)
DDT	4.2	(1.8-5.6)	1.8	(1.0-3.1)
Phorate	5.0	(2.8-7.0)	0.60	(0.30-0.80)
Imidan (R)	5.2	(3.8-7.0)	4.2	(3.4-5.2)
Methoxychlor	5.6	(3.2-7.6)	1.8	(1.2-2.8)
Endrin	10	(6.0-17)	1.3	(0.28-2.4)
Mevinphos	14	(12-16)	2.8	(2.0-3.9)
Lindane	28	(20-39)	11	(8.0-15)
Naled	32	(20-51)	18	(16-20)
EPN	40	(32-48)	7	(3.8-10)
Toxaphene	47	(36-58)	6	(3.0-10)
Phosphamidon	62	(45-84)	22	(18-27)
Disulfoton	100	(60-170)	21	(17-27)
Heptachlor	140	(110-180)	40	(28-55)
VC-13	760	(470-1,230)	260	(200-340)
Thanite (R)	1,450	(1,160-1,630)	640	(440-840)
Dieldrin	1,600	(1,400-1,800)	600	(420-850)
Oxydemetonmethyl	5,600	(4,300-6,900)	1,100	(900-1,330)
Ruelene (R)	5,800	(5,200-6,400)	3,500	(3,000-4,100)
Lethane-60 (R)	6,400	(6,100-6,600)	4,200	(4,000-4,300)
Aldrin	52,000	(38,000-69,700)	5,600	(3,600-8,700)

1/ 95 percent confidence limits in parentheses.

Table 5.--Toxicity values of some insecticides for scud, Gammarus fasciatus, calculated from static and intermittent-flow bioassays conducted in raw water at 21° C.

Insecticide	Estimated TL50 values in micrograms per liter — In static bioassays at-- 24 hours	48 hours	96 hours	5 days	In intermittent-flow bioassays at-- 24 hours	48 hours	96 hours	5 days
Malathion	3.2	2.0	0.9	0.48	1.2	0.50	0.50	0.50
DDT	4.2	3.1	1.8	0.32	1.1	1.0	0.80	0.60
Parathion	6.0	4.0	2.1	1.60	8.6	5.1	4.50	3.90
Endrin	10.0	5.6	1.3	0.90	10.0	7.0	5.50	5.00

more than twice as concentrated as those in the static system.

Glass shrimp

The compound most toxic to late-instar glass shrimp was azinphosmethyl (24-hour TL50 value of 0.76 µg/l), whereas the least toxic was malathion (24-hour TL50 value of 320 µg/l). Both of these compounds belong to the organophosphate group (table 6). The TL50 values for 5-day exposure to DDT, parathion, and fenthion were similar in static and intermittent-flow systems (table 7). Glass shrimp exposed for 5 days to Zectran showed 10 times greater resistance in intermittent-flow tests than in static tests. Malathion was considerably less toxic to glass shrimp in static tests than in the intermittent-flow tests.

In long-term (20-day) intermittent-flow tests with glass shrimp, azinphosmethyl showed a progressive reduction in TL50 values from 1.2 µg/l at 5 days to 0.16 µg/l at 20 days (table 8). The TL50 value of fenthion decreased sharply between 1 and 5 days of continuous exposure followed by a less rapid change during the next 16 days. A progressive reduction in TL50 values between 1 and 5 days of exposure was demonstrated for Zectran (R). Between 5 and 10 days the values decreased sharply and little change was recorded between 10 and 20 days.

Crayfish

The toxicity of the insecticides to large mature crayfish ranged from the highly toxic parathion to the relative nontoxic malathion (table 9). The first noticeable response of crayfish exposed to parathion was the development of excitability, followed by a lack of coordinated movements, immobilization, and death within 6 hours at a concentration of 180 µg/l. Malathion did not kill crayfish in a concentration of 100,000 µg/l for 96 hours. Muncy and Oliver (1963) found that DDT, endrin, and methyl parathion were highly toxic to red crayfish (Procambarus clarki Girard). They also reported that malathion caused no mortality with red crayfish in concentrations up to 20,000 µg/l.

Toxicity levels may vary depending on the age of crustaceans in laboratory tests (Sanders, 1969). We were able to work with crayfish of various ages since they were easily reared in our laboratory. The susceptibility of crayfish of various ages to DDT was determined in static bioassays (table 10); the 96-hour TL50 values were approximately the same for 1-day-old and 3-week-old crayfish. Crayfish 8 weeks old and older were considerably more resistant to DDT; this apparent resistance continued to increase with age and growth.

Smaller, early-instar crayfish appeared to be more susceptible to given concentrations

Table 6.--Toxicity values of various technical grade insecticides for glass shrimp, *Palaemonetes kadiakensis*, calculated from static bioassays conducted in raw water at 21° C.

Insecticide	TL50 values 1/ in micrograms per liter at 24 hours		at 96 hours	
Azinphosmethyl	0.76	(0.64-0.86)	0.13	(0.11-0.15)
DDT	6.80	(6.2-7.50)	2.30	(1.30-4.9)
Parathion	10	(7.0-14)	1.50	(0.82-2.7)
TDE (DDD)	11	(8.4-16)	0.68	(0.47-1.1)
EPN	13	(10-15)	0.56	(0.41-0.75)
Endrin	14	(9.0-24)	3.20	(1.80-5.8)
Carbophenothion	18	(12-27)	1.20	(0.80-1.4)
Heptachlor	30	(22-46)	1.80	(1.40-2.4)
Methoxychlor	34	(25-41)	1.00	(0.70-1.3)
Dieldrin	87	(60-110)	20	(14-27)
Toxaphene	90	(70-110)	28	(22-40)
Aldrin	120	(90-160)	50	(38-65)
Carbaryl	120	(100-140)	5.6	(3.6-8.3)
Chlordane	120	(90-160)	10	(7.0-13)
Ethion	140	(110-170)	5.7	(3.6-8.3)
Naled	180	(130-250)	90	(70-110)
Fenthion	180	(110-200)	10	(7.1-14)
Disulfoton	200	(180-260)	38	(31-52)
Mevinphos	210	(190-280)	12	(9.4-15)
Malathion	320	(200-500)	90	(67-120)

1/ 95 percent confidence limits in parentheses.

of insecticides than were larger, later instars. To verify this, specimens of crayfish were separated into two size (and age) groups: 0.03-0.05 gram and 7-11 grams. The eight insecticides were much more toxic to small than to large crayfish (tables 9 and 11). Young crayfish (0.03-0.05 gram) were exposed to DDT in intermittent-flow bioassays for 20 days. The TL50 of DDT decreased rapidly with time of exposure from 3 µg/l at 24 hours to 0.7 µg/l at 5 days, and less rapidly

Table 7.--Toxicity values of some technical grade insecticides for glass shrimp, *Palaemonetes kadiakensis*, calculated from static and intermittent-flow bioassays conducted in raw water at 21° C.

Insecticide	Estimated TL50 values in micrograms per liter							
	In static bioassays at--				In intermittent-flow bioassays at--			
	24 hours	48 hours	96 hours	5 days	24 hours	48 hours	96 hours	5 days
Azinphosmethyl	0.8	0.5	0.2	0.2	2.5	1.8	1.2	1.2
DDT	6.8	4.7	2.3	1.0	9.4	7.7	3.5	1.3
Parathion	10	5.0	1.5	1.5	10	8.0	5.0	2.5
Endrin	14	8.1	3.2	2.4	13	5.0	0.5	0.4
Zectran	90	45	12	6.0	120	99	83	83
Chlordane	120	10	10	8.0	90	32	4.0	2.5
Fenthion	180	56	10	5.0	170	51	5.8	4.8
Malathion	320	100	90	60	150	25	12	5.0

Table 8.--Toxicity values of three technical grade insecticides for glass shrimp, *Palaemonetes kadiakensis*, calculated from intermittent-flow bioassays conducted for 20 days in raw water at 21° C.

Insecticide	TL50 values 1/ in micrograms per liter at--				
	24 hours	5 days	10 days	15 days	20 days
Azinphosmethyl	2.5 (0.82-3.7)	1.2 (0.61-2.6)	0.65 (0.21-2.1)	0.55 (0.20-1.4)	0.16 (0.076-0.35)
Zectran	120 (82-188)	83 (18-170)	33 (10-100)	28 (5.2-70)	25 (5.1-60)
Fenthion	170 (80-210)	4.8 (2.9-25)	3.2 (2.0-5.0)	2.1 (1.5-3.0)	1.5 (0.5-2.8)

1/ 95 percent confidence limits in parentheses.

for the subsequent 5 days. No change occurred in the remaining 10 days.

Aquatic sowbug

Toxicities of some insecticides to mature sowbugs, isopod crustaceans, ranged from a 96-hour TL50 value of 1.5 µg/l for endrin to 3,000 µg/l for malathion (table 12). With the exception of azinphosmethyl from the organophosphate group, the organochlorine insecticides were much more toxic. Carbaryl, a methylcarbamate insecticide, was intermediate in toxicity.

Comparative toxicity

It is apparent from table 13 that there is no correlation in the acute toxicity of the different insecticides to invertebrates and fish. The 96-hour TL50 values varied

Table 9.--Toxicity values of various technical grade insecticides for mature crayfish, *Orconectes nais*, calculated from static bioassays conducted in raw water at 21° C.

Insecticide	TL50 values 1/ in micrograms per liter at 24 hours	at 96 hours
Parathion	86 (40-120)	15 (7-30)
Phorate	240 (190-260)	50 (30-75)
Endrin	400 (360-480)	320 (280-410)
Fenthion	880 (810-940)	210 (190-230)
DDT	1,100 (1,000-1,400)	100 (80-120)
Carbaryl	2,900 (2,500-3,400)	1,000 (960-1,100)
Naled	4,200 (4,000-4,400)	1,800 (1,750-1,900)
Bidrin (R)	8,600 (8,000-9,500)	5,500 (5,100-6,300)
Dieldrin	10,000 (7,500-14,000)	740 (680-1,200)
Phosphamidon	15,000 (13,500-17,000)	7,500 (6,800-9,700)
Malathion	No apparent effect at 96-hour exposure at 100,000	

1/ 95 percent confidence limits in parentheses.

Table 10.--Toxicity values of DDT to various ages of crayfish *Orconectes nais*, calculated from static bioassays conducted in raw water at 21° C.

Age	Average weight in milligrams	TL50 values 1/ in micrograms per liter at 24 hours		at 96 hours	
1 day	15	1.4	(1.1-4.2)	0.30	(0.18-0.5)
1 week	20	1.0	(0.6-5.0)	0.18	(0.12-0.3)
2 weeks	23	1.2	(0.9-5.5)	0.20	(0.16-1.1)
3 weeks	30	1.0	(0.6-5.0)	0.24	(0.10-0.6)
5 weeks	50	3.2	(1.8-8.0)	0.90	(0.70-1.4)
8 weeks	500	45	(40-52)	28	(24-36)
10 weeks	1,200	50	(48-56)	30	(26-42)

1/ 95 percent confidence limits in parentheses.

considerably for six common insecticides to the four species of crustaceans, four species of immature aquatic insects, and a species of fish. For example, the stonefly and burrowing mayfly nymphs were the most resistant organisms to DDT, with 96-hour TL50 values of 1,800 µg/l for *P. californica* and 1,000 µg/l for

Table 11.--Toxicity values of various technical grade insecticides for 3- to 5-week-old crayfish, *Orconectes nais*, calculated from static bioassays conducted in raw water at 21° C.

Insecticide	TL50 values 1/ in micrograms per liter at 24 hours		at 96 hours	
Parathion	0.1	(0.02-0.4)	0.036	(0.01-0.20)
DDT	1.0	(0.65-5.0)	0.24	(0.10-0.60)
Methoxychlor	2.6	(0.90-8.6)	0.50	(0.25-1.8)
Heptachlor	14	(10-21)	7.8	(4.1-11)
Endrin	20	(16-24)	3.2	(1.6-7.5)
Carbaryl	34	(28-42)	8.6	(5.2-14)
Malathion	290	(210-370)	180	(140-230)
Fenthion	350	(290-460)	50	(35-90)

1/ 95 percent confidence limits in parentheses.

H. bilineata. The scud and glass shrimp were the most sensitive organisms to DDT, with respective 96-hour TL50 values of 3.2 and 2.3 µg/l. Malathion, one of the most toxic organophosphate insecticides to scuds and bluegills, was relatively nontoxic to crayfish.

These differences in toxicity may be expected, as there is also a wide range in the toxicity of insecticides to related species of aquatic insects. For example, [illegible]hock (1965) reported TL50's of DDT for three species of Mayfly nymphs. He found that DDT was most toxic to *Isonychia* sp. with a 24-hour TL50 value of 20 µg/l. Following in descending order of sensitivity were *Ephemerella aurivillii*, 4,800 µg/l and *Ephemerella subvaria*, [illegible]7,300 µg/l. Gaufin (1965) concludes that the variations in sensitivity of aquatic animals to insecticides may be directly correlated with the metabolic rate, the micro-habitat, and the food source for each species.

SUMMARY AND CONCLUSIONS

The acute toxicities of 40 insecticides to scud, glass shrimp, crayfish, and sowbug were determined in 24- and 96-hour static bioassays. Long-term toxicities of some insecticides to crustaceans were measured by continuous exposure for 20 days in an intermittent-flow bioassay system.

Among the four species of crustaceans, scud was generally the most sensitive to insecticides, followed by glass shrimp, sowbug, and crayfish. The toxicities varied greatly, ranging from a 96-hour TL50 value of 0.15 ppb for coumaphos and scud, to the relative nontoxic malathion and crayfish, at 100,000 ppb. Malathion was the least toxic insecticide tested to three of the four species of crustacea.

Early instar crayfish showed a greater sensitivity to insecticides than adult crayfish. There was no significant difference in toxicity of DDT to crayfish between

Table 12.--Toxicity values of various technical grade insecticides for sowbug, Asellus brevicaudus, calculated from static bioassays conducted in reconstituted water at 21° C.

Insecticide	TL50 values 1/ in micrograms per liter at 24 hours		at 96 hours	
DDT	8.7	(4.9-13.0)	4.0	(1.2-6.5)
Endrin	17	(15-19)	1.5	(0.9-3.7)
TDE (DDD)	18	(14-25)	10	(7.0-14)
Dieldrin	22	(19-23)	5.0	(3.2-10)
Aldrin	50	(30-80)	8.0	(6.1-15)
Methoxychlor	100	(85-125)	3.2	(1.8-7.1)
Lindane	110	(90-140)	10	(7.0-14)
Azinphosmethyl	150	(130-190)	21	(16-36)
Carbaryl	320	(300-380)	240	(210-260)
Naled	1,100	(980-1,250)	230	(180-290)
Mevinphos	1,500	(1,380-1,800)	56	(32-95)
Carbophenothion	1,800	(1,600-3,400)	1,100	(800-2,700)
Fenthion	3,200	(2,800-4,900)	1,800	(1,100-4,900)
Parathion	5,600	(3,200-7,500)	600	(200-2,100)
Malathion	6,000	(3,000-10,000)	3,000	(1,500-8,500)

1/ 95 percent confidence limits in parentheses.

1 day and 21 days of age, but they were considerably more resistant to DDT after they were 2 months old.

Some insecticides were slightly more toxic to scud in raw water than in reconstituted water but in most instances the differences in toxicities were not statistically significant.

The toxicities of some insecticides to crustaceans were similar after 5 days of exposure in static and intermittent-flow bioassays. There was a progressive reduction in TL50 values between 1 and 20 days of continuous insecticide exposure.

Some insecticides are extremely toxic to aquatic invertebrates and the presence of these compounds in the aquatic environment may present a hazard to organisms of the aquatic food chain. The results of these experiments serve as a basis for estimating the toxic effects of a wide variety of insecticides on freshwater crustaceans. Knowledge of a wide spectrum of toxicity values for aquatic organisms, tested against a multitude of pesticides, will provide basic data for future pesticide programs which may help in preventing losses of this indispensable segment of aquatic ecosystems.