

# Acute Toxicity of the Insecticides Toxaphene and Carbaryl and the Herbicides Propanil and Molinate to Four Species of Aquatic Organisms

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The insecticides Toxaphene and Carbaryl, and the herbicides Propanil and Molinate are being widely used in agricultural areas. These materials may enter aquatic ecosystems by runoff or may be directly introduced through carelessness during application.

The objectives of this study were determining the median tolerance limits ( $TL_m$ ) of these biocides to Gambusia affinis (mosquitofish), Palaemonetes kadiakensis (grass shrimp), Procambarus simulans (crayfish), and Rangia cuneata (mactrid clam).

These species were selected because of their ecological importance in aquatic food webs and their abundance in local waters. Rangia shell is of commercial value and the meat is eaten by man in part of its distribution range.

## MATERIALS AND METHODS

The toxicants were provided by Texas A & M Agricultural Research Station, Beaumont, Texas. The Carbaryl was a microfine wettable powder (80% active ingredients). The Toxaphene, Propanil, and Molinate were in liquid form with concentrations of 6 lbs/gal., 3 lbs/gal., and 8 lbs/gal., respectively.

All test animals except Rangia were collected from roadside ditches in Jefferson County, Texas. The Rangia were collected from the Neches River in Beaumont.

The Gambusia affinis were 30 - 40 mm total length, Procambarus simulans were 60 - 70 mm rostrum-telson length, Palaemonetes kadiakensis were 25 - 31 mm rostrum-telson length, and Rangia cuneata were 35 - 50 mm shell length.

The animals were acclimated in the laboratory in aged tap water, except for Rangia which were held in 5 0/00 salinity prepared with commercial "Instant Ocean." The test containers were wide-mouth gallon jars or polyethylene pans. Different containers were used for each type of toxicant.

The procedures used to determine the 24, 48, 72, and 96 hour  $TL_m$  values were essentially those listed in STANDARD METHODS... (AMERICAN PUBLIC HEALTH ASSOC., 1971). Carbaryl was tested in two ways: (1) direct application of weighed amount of wettable powder and (2) dissolving the powder in acetone. When acetone was used the containers were aerated for 12 to 24 hours, to ensure evaporation of the acetone before testing.

The Gambusia affinis were judged dead when no movement of the gills or opercules occurred. The Procambarus simulans and Palaemonetes kadiakensis were considered dead when they failed to respond to antennal or leg stimuli. The Rangia cuneata were judged dead when the valves opened permanently or remained open when forced by pressure.

## RESULTS AND DISCUSSION

The 24, 48, 72, and 96 hour  $TL_m$  values are listed on Table 1. The insecticide Toxaphene was the most toxic material to all species, except Rangia cuneata. The herbicide Molinate was most toxic to Rangia.

The Carbaryl was slightly more toxic in powder form than when dissolved in acetone. This may have been due to undissolved particles that coated the gills of the organisms and may have blocked gas exchange. NAQVI and FERGUSON (1970) reported Palaemonetes kadiakensis to have a 24-hour  $TL_m$  of 0.042 mg/l to Carbaryl in acetone, as compared to 0.41 and 0.42 mg/l in this study. The authors just mentioned used 95 - 98 % active ingredients, while 80 % wettable powder was used in this study. Also, test animals of the same species from different geographical locations exhibit different tolerances to the same material due to development of resistance (FERGUSON et al., 1965). All of our test animals were collected around rice fields that had been routinely treated with herbicides and insecticides through the years.

Rangia cuneata was the most tolerant of the species tested to all four biocides. This may be due to: (1) estuarine species are eury-tolerant to many environmental factors and possibly to some toxicants (OLSON and HARREL, 1973); (2) Rangia closed their valves during the first portion of the tests and did not siphon, and (3) many materials, including Toxaphene, break down faster in saline water than in freshwater (HOOPER and GRZENDA, 1955).

TABLE 1  
Median Tolerances Limits (mg/l)\*

Species	Toxicant	24 hr	48 hr	72 hr	96 hr
<u>Gambusia affinis</u>	Toxaphene	0.045	0.024	0.009	0.008
	Carbaryl	40.00 (42.50)	35.00 (36.20)	32.40 (33.60)	31.80 (32.80)
	Propanil Molinate	11.30 30.70	11.00 21.40	10.17 17.10	9.46 16.40
<u>Palaemonetes kadiakensis</u>	Toxaphene	0.091	0.068	0.046	0.036
	Carbaryl	0.41 (0.42)	0.24 (0.32)	0.14 (0.29)	0.12 (0.26)
	Propanil Molinate	22.75 22.00	20.00 20.00	13.65 18.00	19.00 15.90
<u>Procambarus similans</u>	Toxaphene	0.45	0.29	0.24	0.21
	Carbaryl	2.87 (3.02)	2.66 (2.87)	2.43 (2.73)	2.43 (2.65)
	Propanil Molinate	40.08 34.70	33.80 33.20	28.70 23.00	28.30 21.80
<u>Rangia cuneata</u>	Toxaphene	940	699	480	460
	Carbaryl	>2000 (>2000)	1860 (1890)	350 (355)	125 (190)
	Propanil Molinate	750	716 385	594 290	132 197

\* Numbers in parenthesis are the TL<sub>m</sub> values for Carbaryl in acetone

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