EFFECTS OF METHOXYCHLOR ON LARVAL DEVELOPMENT OF MUD-CRAB AND BLUE CRAB

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Abstract. Laboratory experiments were conducted to determine the effects of methoxychlor on the larval development of the mud-crab, *Rhithropanopeus harrisii*, and the commercial blue crab, *Callineetes sapidus*, from the time of hatching until the 1st crab stage was reached.

The effect of a range of concentrations of methoxychlor on survival of larvae of *C. sapidus* and *R. harrisii* was determined, as well as the concentrations which were sublethal and lethal. Since concentrations as low as 1.3, 1.6 and 1.9 ppb (μg l⁻¹) methoxychlor were acutely toxic to *C. sapidus* larvae, and it took a concentration as high as 7.0 ppb to be acutely toxic to *R. harrisii* larvae, it was concluded that *C. sapidus* larvae were much more sensitive to methoxychlor than *R. harrisii* larvae. Zoeal and total development to the 1st crab stage of *R. harrisii* and *C. sapidus* were prolonged in relation to increased concentrations of methoxychlor. The developmental stages in which larvae were particularly sensitive varied in the two species. Methoxychlor residues of *R. harrisii* and *C. sapidus* larvae reared in concentrations of methoxychlor were determined.

1. Introduction

Methoxychlor is one of the chlorinated hydrocarbon insecticides which is used to replace DDT, now banned in the United States. It is employed chiefly to control the smaller European elm bark beetle, blackfly larvae in streams, and different pests on vegetables, fruit and grain (Burdick *et al.*, 1968; Wallner *et al.*, 1969; U.S. Department of Agriculture, 1968). Methoxychlor is nearly as toxic to target organisms as DDT, but is biodegradable. Hence, it does not produce residues as long lasting as those of DDT (Burdick *et al.*, 1968; Metcalf *et al.*, 1971).

Although methoxychlor is generally considered to be a moderately hazardous insecticide, it has been shown to be highly toxic to juvenile and adult striped mullet, *Mugil cephalus*, in acute toxicity tests (Lee *et al.*, 1975), and to the fathead minnow, *Pimephales promelas*, and yellow perch, *Perca flavescens*, in chronic toxicity studies (Merna and Eisele, 1973). There is a scarcity of papers on the effect of methoxychlor on estuarine and marine decapods. Eisler (1969) determined that the 96 h LC₅₀ was 4 μg l⁻¹ (micrograms per liter) for the sand shrimp, *Crangon septemspinosa*, 12 μg l⁻¹ for the grass shrimp, *Palaemonetes vulgaris*, and 7 μg l⁻¹ for the hermit crab, *Pagurus longicarpus*, when maintained in a salinity of 24.9/₀₀ and a temperature of 20°C.

If water quality standards are to be established for estuaries, the sensitivity of larval, juvenile and adult shrimps and crabs to chronic exposure of insecticides should be considered. There are numerous examples in the literature to indicate that juvenile decapods are more sensitive to chlorinated hydrocarbon insecticides than adults (Ludke
et al., 1971; Buchanan et al., 1970; McKenzie, 1970; Lowe et al., 1971). It might be expected, therefore, that crabs in larval stages would be more sensitive than juveniles. There are relatively few papers in the literature, however, on the effects of different concentrations of insecticides on the larval development of crabs. Buchanan et al. (1970) reported that larvae in the first zoeal stage of the dungeness crab, Cancer magister, were more sensitive to Sevin, a carbamate, than juveniles, and juveniles more sensitive than adults. Epifanio (1971) found that early stage larvae of two species of xanthid crabs, Leptodius floridanus and Panopeus herbstii, were more sensitive to different concentrations of dieldrin than larvae of later stages. When the mud-crab, Rhithropanopeus harrisii, the stone crab, Menippe mercenaria, and the blue crab, Callinectes sapidus, were exposed to four concentrations of mirex throughout larval development, larvae in the first two zoeal stages were the least susceptible except when reared in the highest concentration (Bookhout et al., 1972; Bookhout and Costlow, 1975). Despite the suspicion that crab larvae may be more sensitive to insecticides than juveniles, there are so few species in which the chronic effects of insecticides on larvae and juveniles are known that it is premature to make generalizations.

So far as is known, there have been no investigations on the effect of methoxychlor on the complete larval development of any crab. The objective of the current investigation, therefore, was to determine the limits of concentrations of methoxychlor within which the mud-crab, Rhithropanopeus harrisii, the stone crab, Menippe mercenaria, and the blue crab, Callinectes sapidus, could be reared, and to determine the sublethal and acutely toxic concentrations of methoxychlor, the sublethal effects, the most sensitive periods of development, and the accumulation of methoxychlor residues for the two species.

2. Materials and Methods

2.1. Preparation

Preliminary experiments were conducted to determine the range of concentrations of methoxychlor to use in definitive chronic studies on the effect of methoxychlor on the complete larval development of Rhithropanopeus harrisii Gould and Callinectes sapidus Rathbun.

Pesticide grade acetone was used as a carrier for methoxychlor because in preliminary studies there was no significant difference in survival of larvae reared in seawater and 1 ppt (parts per thousand) insecticide grade acetone. Acetone control for experiments with methoxychlor was prepared by adding 1 ml of full strength acetone of insecticide grade to 999 ml of 20% filtered seawater for R. harrisii larvae and 30% filtered seawater for C. sapidus larvae to give a final concentration of 1.0 ppt.

Methoxychlor (1,1,1-trichlor-2,2-bis p-methoxyphenylethane) was secured from E. I. duPont de Nemours Company and had a purity of 99%. Hazelton Laboratories America, Inc., prepared the stock solutions by dissolving a known weight of methoxychlor in pesticide analytical grade acetone, and various concentrations were made up from this stock solution.