Parathion and Methyl Parathion Toxicity to Insecticide-Resistant and Susceptible Mosquitofish

(Gambusia affinis)

by

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INTRODUCTION

One population of mosquitofish (Gambusia affinis) occurring in the highly agricultural delta region of Mississippi demonstrates resistance to a wide range of organochlorine compounds when compared to a susceptible population. The former population will be designated as R (organochlorine compound-resistant) and the latter as S (organochlorine compound-susceptible). There is reported to be a 4.2 fold difference in the organophosphorus insecticide, parathion, 48-h LC₅₀ values (the concentration of toxicant which will cause 50% mortality in 48 h) between the R and S population (CULLEY and FERGUSON, 1969). Because of the low toxicity of methyl parathion, LC₅₀ values were not determined for it.

The objectives of this study were to determine the levels of tolerance of mosquitofish to parathion and methyl parathion and to determine whether resistance to these two compounds appears to exist.

MATERIALS AND METHODS

Susceptible mosquitofish (Gambusia affinis) were collected from ponds having no known insecticide exposure near Starkville, Oktibbeha County, Mississippi. Resistant fish were collected from drainage ditches adjacent to cotton fields near Belzoni, Humphreys County, Mississippi. Fish were held in the laboratory in dechlorinated tap water under constant conditions of temperature and nutrition. Over 80% of the fish used were adult females. Insecticides used were 99% pure.

Dosage Mortality Studies

Dosage mortality studies for parathion in the spring and fall and methyl parathion in the fall only were conducted in 8-liter all-glass aquaria in dechlorinated tap water. A fish

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density of 2 fish per liter was used with either 10 or 16 individuals per aquarium. The fish were allowed to acclimate to the aquaria for one day prior to the introduction of the insecticide.

The insecticides were dissolved in methoxyethanol to form stock solutions which were added to the aquaria at 0.1 ml/l of water to yield the appropriate final concentration (0.1 to 1 ppm parathion and 1.2 to 17 ppm methyl parathion). (Methoxyethanol alone was non-toxic in the quantity used.) LC₅₀ values for 48 h were determined from a computerized log probit analysis. Between 70 and 140 individuals were employed for each LC₅₀ determination.

RESULTS

The parathion 48-h LC₅₀ values in the spring for S and R fish were 0.61 ppm and 0.95 ppm, respectively, while in the fall the values were 0.35 ppm and 0.39 ppm for S and R fish, respectively. Thus, R fish tolerated about 1.5 times more parathion than S fish in the spring, and 1.1 times in the fall. The methyl parathion 48-h LC₅₀ for S fish was 13.48 ppm and for R fish 17.18 ppm, yielding a fold difference of about 1.3. The 95% confidence intervals did not overlap for any of the LC₅₀'s determined except parathion values for S and R populations in the fall (Table 1).

<table>
<thead>
<tr>
<th>Insecticide</th>
<th>Population</th>
<th>Season</th>
<th>Lower limit</th>
<th>LC₅₀</th>
<th>Upper limit</th>
<th>Slope⁹</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>S</td>
<td>fall</td>
<td>0.29</td>
<td>0.35</td>
<td>0.43</td>
<td>1.88</td>
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<tr>
<td>P</td>
<td>R</td>
<td>fall</td>
<td>0.12</td>
<td>0.39</td>
<td>0.50</td>
<td>2.00</td>
</tr>
<tr>
<td>P</td>
<td>S</td>
<td>spring</td>
<td>0.51</td>
<td>0.61</td>
<td>0.69</td>
<td>10.95</td>
</tr>
<tr>
<td>P</td>
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<td>0.89</td>
<td>0.95</td>
<td>1.01</td>
<td>7.00</td>
</tr>
<tr>
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<td>S</td>
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<td>13.48</td>
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<td>27.69</td>
</tr>
<tr>
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<td>R</td>
<td>fall</td>
<td>15.67</td>
<td>17.48</td>
<td>27.38</td>
<td>4.65</td>
</tr>
</tbody>
</table>

⁹slope of the log probit regression line

There was an apparent increase in toxicity of parathion to R fish with the length of time the fish were held in the laboratory. Tolerance was highest when the fish were first collected. Thereafter tolerance gradually declined and by the