LABORATORY EVALUATION OF VECTOBAC® AS AGAINST *Aedes aegypti* IN MONTERREY, NUEVO LEÓN, MEXICO

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**ABSTRACT** Intensive use of the organophosphate insecticide malathion against adults and temephos against larvae of *Aedes aegypti* in Mexico over the past 30 years has led to problems requiring the use of new insecticides. Toward this objective, *Bacillus thuringiensis* var. *israelensis* (Bti), a target-specific and environmentally safer alternative to insecticides, was evaluated in laboratory bioassays done to determine the susceptibility of 2nd- and 3rd-stage larvae of *Ae. aegypti* to Vectobac® 12 AS (aqueous suspension, 600 IU/μg). A median lethal concentration of 0.0104 ppm and a 95% lethal concentration of 0.18 ppm were determined after 24 h of exposure to the agent. The values obtained were adjusted for field application and were further tested in the field by the State of Nuevo Leon, Mexico Vector Control Program. Suspensions of Bti were poured into pipe-water tanks and transferred to domestic 200-gal metal water drums. Larval populations were reduced during a 2-week study period. However, residents complained about a fine dusty film on the water surface. Nevertheless, these results are promising for future Bti field applications.

**KEY WORDS** Dengue, insecticide resistance, mosquito control, *Bacillus thuringiensis* var. *israelensis*, Vectobac®

**INTRODUCTION**

Classical dengue, along with its more serious sequelae, hemorrhagic fever and dengue shock syndrome, is a serious health problem in many parts of the Americas, and may affect national economies in the region (PAHO 1994). Dengue appeared in Mexico during the late 1970s, and since then, yearly outbreaks have occurred consistently throughout temperate and tropical areas (Gómez-Dantés 1992). Dramatically, the northeastern region covering the states Tamaulipas, Nuevo León, and Coahuila reported nearly 70% of the 14,000 confirmed cases registered nationwide (Secretaría de Salud, Mexico 1999). The increasing trend of dengue outbreaks is blamed on several factors. Notably, traditional, centralized, and vertically structured programs are largely ineffective, principally because they are neither affordable nor manageable. In addition, the explosive growth of urban areas, limited government resources, and inadequate field personnel account for the epidemic dispersal in Latin America (Gubler and Kuno 1997). On the other hand, the excessive reliance on and improper application of insecticides, plus reports of insecticide resistance, have all brought attention to the need for alternative control methods. Insecticides have exerted a selective pressure that has favored the survival of strains with increased resistance. In Mexico, as in most countries, many different insecticides have been used for vector control. In the 1950s, DDT was used for malaria control. Since then, organophosphate insecticides such as malathion (adulticide) and temephos (larvicide), have been employed extensively. Malathion was used as a space spray or applied by ultra-low volume cold fogging, whereas temephos granules were applied to water containing domestic and peri-domestic infestations of *Aedes aegypti* (L.). In Monterrey City, both 200-liter metal drums and discarded tires have become the most important breeding sites for *Ae. aegypti* larvae. Therefore, since 1981, larval control has been conducted intensely annually with 1% temephos granules. Presently, strong indications exist that resistance to this organophosphate is occurring, and temephos resistance has been confirmed elsewhere in the Caribbean area. Wirth and Georgiou (1999) reported resistance in the Virgin Islands, where temephos has been used intensively in the *Ae. aegypti* Dengue Control Program.

Development of resistance to *Bacillus thuringiensis* var. *israelensis* (Bti) by mosquitoes has been much less pronounced (Georgiou and Wirth 1977), and this insecticide has proven to be highly efficient for the control of many mosquito species and is relatively non-disruptive to aquatic environments. After a dengue outbreak in 1999, the Nuevo León State *Ae. aegypti* Control Program requested tests on the use of Vectobac® 12 AS, the Bti product available in the Mexican market. The aims of the study were the determination of *Ae. aegypti* susceptibility to Bti under laboratory conditions and the establishment of field application rates for local mosquito breeding sites.

**MATERIALS AND METHODS**

*Aedes aegypti* susceptibility: Vectobac 12 AS (aqueous suspension, 600 IU/μg) of Bti (H-14) manufactured by Abbott Laboratories, North Chicago, II, USA, was used to determine mortality-concentration lines. The bioassays utilized 2nd- and 3rd-stage larval *Ae. aegypti*. Laboratory ambient conditions were 70% relative humidity and 28-
29°C. The photoperiod was maintained at 12:12 h light:dark.

Larvae were collected from the city cemetery Campo Santo "El Roble." Larvae thriving in cemetery vases were taken to the Medical Entomology Laboratory at the University of Nuevo León. Larvae were identified and reared in 30 x 30-in. plastic trays. Larvae were fed ground dog food. Adults were fed 10% sugar water. Females were also allowed to take blood meals from mice. Field-collected larvae were added every 2 months. The larvae hatched from eggs obtained in the laboratory corresponding to the F₁ progeny were utilized for bioassays.

Bioassays were conducted as recommended by the World Health Organization (1981); a total of 9 bioassays was conducted. Each of the bioassays included 8 different 

\[ \text{Bti concentrations (ppm)} \]

<table>
<thead>
<tr>
<th>Bioassay</th>
<th>Bti concentrations (ppm)</th>
<th>Number of exposed larvae</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0, 0.0001, 0.0004, 0.0008, 0.015, 0.030, 0.06</td>
<td>360</td>
</tr>
<tr>
<td>2</td>
<td>0, 0.0015, 0.0030, 0.0060, 0.0120, 0.024</td>
<td>360</td>
</tr>
<tr>
<td>3</td>
<td>0, 0.0001, 0.0009, 0.012, 0.025, 0.050, 0.035, 0.040</td>
<td>240</td>
</tr>
<tr>
<td>4</td>
<td>0, 0.0006, 0.009, 0.012, 0.025, 0.050, 0.035, 0.040</td>
<td>540</td>
</tr>
<tr>
<td>5</td>
<td>0, 0.0006, 0.009, 0.012, 0.025, 0.050, 0.035, 0.040</td>
<td>420</td>
</tr>
<tr>
<td>6</td>
<td>0, 0.0015, 0.0030, 0.0060, 0.0120, 0.024</td>
<td>420</td>
</tr>
<tr>
<td>7</td>
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<td>240</td>
</tr>
<tr>
<td>8</td>
<td>0, 0.0015, 0.0030, 0.0060, 0.0120, 0.024</td>
<td>540</td>
</tr>
<tr>
<td>9</td>
<td>0, 0.0015, 0.0030, 0.0060, 0.0120, 0.024</td>
<td>780</td>
</tr>
</tbody>
</table>

1% stock dilutions was prepared (Table 1) to provide the appropriate concentration ranges to determine mortality-concentration curves. Bioassays were conducted on 2nd and 3rd larval instars of \( Aedes aegypti \). Larvae were not fed during the tests. Mortality readings were taken after 24 h.

Mortality data were analyzed by probit analysis by using the maximum likelihood method (Finney 1977). Data were corrected by using the Abbott (1925) mortality correction formula when necessary.

RESULTS AND DISCUSSION

Figure 1 and Table 1 indicate the concentration-mortality relationship for \( Aedes aegypti \) after 24 h of exposure to Vectobac 12 AS. According to the maximum likelihood method, the median lethal concentration (LC₅₀) for 24 h exposure was 0.010 ppm with a confidence interval of 0.0089–0.0120 ppm and the 95% lethal concentration was 0.184 ppm with a confidence interval of 0.1312–0.2356 ppm (\( P < 0.05 \)).

The results showed a higher LC₅₀ value compared to that observed by Vega (unpublished data), who evaluated a Vectobac AS formulation against \( Aedes aegypti \) collected in several localities.

![Fig. 1. Response to Vectobac AS (24 h) in 2nd and 3rd larval instars of \( Aedes aegypti \) based on the maximum likelihood method.](image-url)
REFERENCES CITED


