PRESENT SUSCEPTIBILITY STATUS OF CULEX QUINQUEFASCIATUS, SAY TO THREE INSECTICIDES IN NAGPUR DISTRICT OF INDIA

S. R. Karlekar, M. M. Deshpande and "R. J. Andrew
Department of Zoology, Hislop College, Nagpur- 440 001 (MS), India
Author for Correspondence

ABSTRACT
The susceptibility of Culex quinquefasciatus the vector of lymphatic filaria to chemical insecticides was evaluated using the WHO standard susceptibility test at diagnostic concentrations of 0.05% Deltamethrin, 4% DDT and 0.10% Alpha-cypermethrin in Nagpur district of India which is endemic for lymphatic filariasis. Our results revealed that Culex quinquefasciatus mosquitoes has developed high level of resistance to diagnostic concentrations used, showing the need to select the most efficacious compounds for this mosquito species to achieve successful control. It would be valuable if the insecticides are used on rotational basis to slow down the selection pressure of insecticides. Biological control measures and the destruction of vector breeding sources can be the most efficient method of controlling disease transmission.

Key Words: Susceptibility, Culex Quinquefasciatus, Deltamethrin, DDT, Alpha-cypermethrin and Nagpur, India

INTRODUCTION
Mosquitoes are the most important among the disease causing vectors that number over 350 species out of about 3500 species. Mosquito-transmitted diseases are the major cause of loss of human life worldwide, with over 700 million people suffering annually (Taubes, 1997). Culex quinquefasciatus is the primary vector of lymphatic filariasis since it is a highly efficient insect host for the larval development of the filarial parasite Wuchereria bancrofti (Rosen, 1955; Crans, 1973; Manga, 2002; Prasittisuk, 2002 and Forattini et al., 1993). It is also a primary vector for arbovirus in tropical and subtropical areas (Sasa, 1976). Because of the anthropophilic and endophilic blood feeding habits of the female, it is closely associated to man and human habitations. Culex quinquefasciatus is found in high density throughout the year due to its high degree of adaptability in its preference for breeding sites, host specificity, and high reproductive potential (Forattini et al., 1993 and Sirivanakaran, 1976). According to the World Health Organization (WHO, 2006), 1.3 billion people are at risk of lymphatic filariasis infections and about 120 million people are affected in 83 countries, of which 45.5 million people live in the Indian subcontinent. About 31 million people are estimated to be the carriers of micro filarial and over 23 million suffer from filarial disease manifestations in India (Sabesan et al., 2010). In central India about 62000 cases of lymphatic filariasis have been documented. Due to the absence of an effective vaccine and considerable side effects of the available chemotherapy, the primary option available for controlling and preventing filariasis is the control of Culex quinquefasciatus (Maizels, 1992). Since the discovery of DDT as a potent insecticide, chemical control has become the method of choice which necessitated the use of other types of insecticides as well. But due to reasons such as indiscriminate use of insecticides and natural adaptation, the vector has developed resistance (Harish Kumar et al., 2011). The WHO Experts Committee has suggested updating knowledge about the status of vector resistance, evaluating current and new methodologies and discussing essential components of resistance management for efficient vector-control programs(WHO, 1992). To avoid indiscriminate use of insecticides and residual effects on human health it is necessary to find the susceptibility of these insecticides time to time in various geographical loci. No recent data is available on the susceptibility status of adult Culex quinquefasciatus in Nagpur district of Maharashtra. The present investigation was undertaken to generate a baseline data on susceptibility status of adult Culex quinquefasciatus in Nagpur district.

MATERIALS AND METHODS
Study area
Nagpur district of Maharashtra state India lies between 20°35 and 21° 44 north latitude and 78° 15 and 79° 40 east longitude at southern base of the Satpuda hills. The total area of the district is 9931 sq. km and the total population (as per 2001 census) is 40.676 lakhs. The population density is 408 persons per sq. km. The recorded literacy rate is 89.52. The district has eleven municipal corporations. Climate is tropical with dry season (February-June), monsoon (July-August) and post-monsoon (September-December). Average temperature ranges between 22°C and 27°C, average relative humidity around 70% to 20% and average annual rainfall of 1205 mm.

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Insect collection

*Culex quinquefasciatus* mosquitoes were collected in the month of January 2012 from the Wathoda, Vihirgaon and Shiva villages of Nagpur district between 6 am to 8 am using glass mouth aspirators.

Insecticide susceptibility tests

Susceptibility of insecticides by tube test method was carried out according to the standard WHO procedure (WHO, 1975 and Mittal et al., 2010). Insecticide-impregnated papers as per diagnostic doses, DDT (4%), Deltamethrin (0.05%), Alpha-cypermethrin (0.10%) were used. Collected *Culex quinquefasciatus* female mosquitoes were exposed to the insecticide-impregnated papers for one hour. Experiments were conducted with a minimum of three replicates with matched controls for each insecticide in a room maintaining temperature at 27 ± 2°C and 75%± 3% relative humidity. The knockdown effect of each insecticide on mosquitoes was recorded after the one hour exposure period. Exposed mosquitoes were then transferred to a recovery tube and provided with 10% glucose solution. Final mortality was recorded after 24 hours of holding time in experimental and control tubes.

RESULTS AND DISCUSSION

The mean susceptibility of *Culex quinquefasciatus* at diagnostic concentrations of Deltamethrin 0.05%, DDT 4%, and Alpha-cypermethrin 0.10% is shown in the Table 1.

<table>
<thead>
<tr>
<th>Name of insecticide</th>
<th>R1</th>
<th>R2</th>
<th>R3</th>
<th>Total</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of Exposed</td>
<td>Dead</td>
<td>No. of Exposed</td>
<td>Dead</td>
<td>No. of Exposed</td>
</tr>
<tr>
<td>Deltamethrin 0.05%</td>
<td>22</td>
<td>16</td>
<td>21</td>
<td>15</td>
<td>23</td>
</tr>
<tr>
<td>Alpha Cypermethrin 0.10%</td>
<td>21</td>
<td>5</td>
<td>22</td>
<td>5</td>
<td>22</td>
</tr>
<tr>
<td>DDT 4%</td>
<td>20</td>
<td>2</td>
<td>22</td>
<td>3</td>
<td>23</td>
</tr>
</tbody>
</table>

As per WHO criteria, 98-100% mortality indicates susceptibility, 80-97% mortality requires confirmation of resistance with other methods and <80% mortality suggests resistance (Vatandoost et al., 2004). The present result indicates that the mosquito *Culex quinquefasciatus* has developed high level of resistance to diagnostic concentrations of Deltamethrin 0.05%, DDT 4%, and Alpha-cypermethrin 0.10% in Nagpur district of India. These insecticides may not be effective for control in this region and may pose a problem of toxicity in nature. In India, Mukhopadhaya et al.(1993) noted resistance of *Culex quinquefasciatus* aganist DDT in the city of Patna (Bihar state) while Sarkar et al.,(2009) observed only 35% mortality with 0.05% Deltamethrin in Assam.

It would be useful if the insecticides are used on rotational basis to slow down the selection pressure of insecticides against the mosquito species. The data obtained from this study can be used in making timely management decisions about the judicious choice of pesticides in a vector control program.

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