Susceptibility of *Culex quinquefasciatus* Say, 1823 (Diptera; Culicidae) to Cyfluthrin, Propoxur and Malathion in the Sudan Savanna, North Eastern Nigeria

1Department of Biological Sciences, Gombe State University, Gombe
2Nigerian Institute of Medical Research, Maiduguri Office, Borno State
3Department of Geography, Gombe State University, Gombe
4Malaria Control Project Booster Project, Gombe State
5Federal University, Kashere, Gombe State

Abstract

The susceptibility of Adult female *Culex quinquefasciatus* to test papers impregnated with 0.15% Cyfluthrin, 0.1% Propoxur and 5% Malathion was assessed using the standard World Health Organization (WHO) protocol insecticide susceptibility test kits and impregnated papers recommended for Indoor Residual Spraying (IRS). Mortality of *Culex quinquefasciatus* recorded 24 hrs post exposure indicated 100% susceptibility to all the 3 insecticides. Results obtained indicate that knockdown of *Culex quinquefasciatus* was related to the duration of exposure indicated by the following equations for each of the insecticides: 0.1%Propoxur Y = -7.7+5.70X, 0.15% Cyfluthrin Y = -4+3.32X and 5%Malathion Y = -5.8+4.30X. The Predicted KDT<sub>50</sub> and KDT<sub>95</sub> were for 0.1% Propoxur, KDT<sub>50</sub> 20.9 mins and KDT<sub>95</sub> 30.2 mins , 0.15% Cyfluthrin KDT<sub>50</sub> 12.7 mins and KDT<sub>95</sub> 18.1 mins, 5% Malathion KDT<sub>50</sub> 15.7 mins & KDT<sub>95</sub> 22.8 mins. All the three insecticides had knockdown times below 1 hr. However the knockdown time of 0.15%Cyfluthrin was clearly lower than each of the other test insecticides. These baseline results are of use in Gombe State in the current control efforts of disease vectors by the Federal Ministry of Health of Nigeria.

Keywords: *Culex* spp, Susceptibility, Malathion, Propoxur, Cyfluthrin, North Eastern Nigeria.

INTRODUCTION

In most of sub-saharan Africa, including Nigeria, malaria occurs concurrently with other mosquito vector borne diseases (Awolola *et al.*, 2006). The management of these diseases and their vectors has mainly been with chemo-therapeutic drugs and pesticides. Some of the causative agents of these diseases especially malaria have developed resistance to the drugs. According to Curtis, (1996) anti malaria programmes in the tropics based on *Anopheles* control only, may fail to win public esteem if scores or hundreds of *Culex* mosquitoes continue to bite people.

Indoor Residual Spraying (IRS) is considered as one of the major vector control interventions frequently used in Nigeria (Awolola *et al.*, 2006). This poses a lot of pollution leading to emergence of resistant strain of vectors (Jacob and Yoriyo, 2015). Sequel to this, the evaluation report of the
mosquitoes to insecticides

Three day old adult nulliparous female *C. quinquefasciatus* were subjected to WHO (2008) standard protocol for insecticide susceptibility test kits and impregnated filter papers. The test mosquitoes were exposed in batches of 20-25 to the filter paper impregnated with 0.15% Cyfluthrin, 0.1% Propoxur and 5% Malathion for each test in four replicates with one control each. Controls included batches of test mosquitoes exposed to untreated papers. The knockdown effect of each insecticide was recorded every 10 minutes over one-hour exposure period. Thereafter, all mosquitoes exposed to the different pesticides were then transferred to a recovery tube and provided with 10% glucose solution and observed for the next 24 hours. The final mortality for mosquitoes in each of the pesticides was recorded 24 hours post-exposure.

**Data analysis**

Insecticide susceptibility bioassays were evaluated according to the recommendations of the WHO (2008). Mortality data from each pesticide was analyzed using a combination of Excel and the
SPSS 16.0. Knock-down times for 50% (KDT$_{50}$) and 95% (KDT$_{95}$) of test insects were estimated respectively using log Probit analysis.

**RESULTS**

Susceptibility of adult mosquitoes reared from larval collection that were exposed to 0.15% Cyfluthrin, 5% Malathion and 0.1% Propoxur for one hour are presented in Table 1. Exposure to each of the insecticides resulted in mean mortality rates of 100% for all the three insecticides tested.

**Knockdown effect**

The knockdown effect obtained is related to the duration of exposure by the following formulas for each of the insecticides: 0.15% Cyfluthrin $Y = -4+3.32X$ and 5% Malathion $Y = -5.8+4.30X$, 0.1% Propoxur $Y = -7.7+5.70X$. Predicted KDT$_{50}$ and KDT$_{95}$ were for, 0.15% Cyfluthrin KDT$_{50}$ 12.7 mins and KDT$_{95}$ 18.1 minutes, 5% Malathion KDT$_{50}$ 15.7 mins and KDT$_{95}$ 22.8mins. 0.1% Propoxur KDT$_{50}$ 20.9 mins and KDT$_{95}$ 30.2 mins. All the three insecticides had knockdown times below 1hr. However the knockdown time of 0.15% Cyfluthrin was clearly more pronounced and faster than the other insecticides as shown in Table 1.

**DISCUSSION**

The results of the present study showed the potency of all the three classes of insecticides in the study area. There was a gradual increase in efficacy with time of exposure. All the three insecticides showed a 100% efficacy at 24 hours exposure period. Based on insecticides resistance criteria developed by the World Health Organization for reporting of vector response to insecticides the result indicates complete susceptibility to all the three insecticides. Integrated Vector Management (IVM) guidelines in addition to malaria vector control also target vectors of several diseases such as lymphatic filariasis, leishmaniasis and trypanosomiasis (WHO, 2008). Results obtained from this study confirm the susceptibility of *Culex quinquefasciatus* to the three classes of approved insecticides in the study area. The pronounced knockdown effect of Cyfluthrin further confirmed the potency and potential role of the Pyrethroids against mosquitoes in the Northeast of Nigeria which is in agreement with Molta *et al* (1990). This also agrees with the technical report of Yoriyo, (2010) on basic sampling methods for baseline entomological data collection on IRS in Gombe State who observed a similar trend in response of *Anopheles spp* to these insecticides. The susceptibility status of *Anopheles spp* and *Culex spp* to these insecticides is a good indicator for opportunistic non target disease control. This may also increase the community acceptance advocacy campaign of target diseases like malaria, since the same insecticide can be used to control these two different mosquito species. Jacob and Yoriyo (2015) also observed the same trend in Akko and

<table>
<thead>
<tr>
<th>Insecticide (Conc.)</th>
<th>Total No. exposed</th>
<th>KDT$_{50}$</th>
<th>KDT$_{95}$</th>
<th>No dead (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.15% Cyfluthrin</td>
<td>80</td>
<td>12.7 (11.0-13.4)</td>
<td>18.1 (17.4-19.0)</td>
<td>80(100)</td>
</tr>
<tr>
<td>5% Malathion</td>
<td>80</td>
<td>15.7 (14.0-17.0)</td>
<td>22.8 (22.0-24.0)</td>
<td>80(100)</td>
</tr>
<tr>
<td>0.1% Propoxur</td>
<td>80</td>
<td>20.9 (20.1-22.0)</td>
<td>30.2 (29.0-31.0)</td>
<td>80(100)</td>
</tr>
</tbody>
</table>
Gombe Local Government Areas of the state with Propoxur insecticides but a high resistance trend with DDT. The similarity in the trend with Propoxur could be attributed to the common use of some agrochemical in the area which may not be from the same class with the Propoxur to warrant for resistance development in these areas. This susceptibility rate of over 98% for all the three insecticides has also been reported by WHO (1997) in The Gambia and many other African countries. Molta et al (1990) also observed a 95% susceptibility in Zaria with Malathion to Culex quinquefaciatus. This similarity in susceptibility may still be attributed to the common environmental agrochemical usages in these areas.

CONCLUSION

The complete susceptibility of all the three different insecticides belonging to different classes gave a wide choice of insecticide for use in the study area for better resistance management especially now that resistant strains have been generating concerns in vector control management. It is suggested that the three insecticides be used interchangeably after a certain period of time for better resistance management.

ACKNOWLEDGEMENTS

We are grateful to the National Malaria Control Programme, for supplying the WHO impregnated papers and the Susceptibility test Kits. We are also thankful to the Malaria Control Booster Project, Gombe State for providing the facilities for rearing and testing of mosquitoes in the insectary. We are also grateful to Mal Ibrahim and Rilwanu for providing the technical assistance in the insectary laboratory and management.

REFERENCES

Awolola, T. S., Idowu, E. T., Adeneye, A. K.,


Yoriyo K.P. (2010). Basic Sampling Method for Baseline Entomological Data Collection, for Indoor Residual Spray (IR S) and Bioassay
Residual Effect Activities in Balanga and Yamaltu Deba LGAs of Gombe State Nigeria.