

## CHAPTER 8

### CONCLUSION

In conclusion, the findings of this present study indicated that permethrin selection of resistance was developing at a faster rate compared to malathion based on the LC<sub>50</sub> values and malathion was a promising chemical larvicidal agent for the control of *Culex quinquefasciatus* larvae. In contrast, permethrin is the most potent adulticide to produce high level of mortality in adult *Cx. quinquefasciatus*. Meanwhile there was some low levels of cross-resistance relationship against propoxur in these both strains.

Present study indicated that permethrin (pyrethroid) selection of resistance was developing at a higher rate compared to malathion and temephos (organophosphates) based on the LC<sub>50</sub> values and resistance ratios. The results exhibited the following insecticides shown degree of potency or effectiveness to larvae of *Aedes aegypti* when comparison made on its resistance ratio (RR) in ascending order permethrin > malathion > temephos. According to the degree of potency that has been shown earlier in this study, it was suggested that temephos is a promising chemical larvicidal agent for the control of *Aedes aegypti* larvae. In contrast, malathion and permethrin were the effective adulticide agent for the control of adult *Aedes aegypti*. There was some degree of cross-resistance relationship against propoxur in these three strains.

Interestingly, the LC<sub>50</sub> for temephos selected *Ae. albopictus* larvae fell well within the diagnostic concentration recommended by WHO 1992, i.e. 0.02 mg/L. Permethrin selected *Ae. albopictus* exhibited overall mean  $\pm$  S.E. for LC<sub>50</sub> 0.28  $\pm$  0.01 and this indicated *Ae. albopictus* was more tolerant to permethrin 14 fold than temephos and 2.5

fold than malathion. Percentage mortality of selected adults were lesser or can be defined as developed cross-resistance against propoxur for malathion and temephos strain and permethrin selected strain found to be moderately resistant to propoxur. In none of the strains did the  $LT_{50}$  approach the World Health Organization (1992) recommended diagnostic dosage. Adult bioassay results for *Ae. albopictus* exhibited permethrin as the most potent insecticide to produce high level of mortality rate in adults.

Individuals with esterase levels above the threshold are less susceptible. The upper range limit at 450 nm is determined as 0.20. Non-specific esterase activity in different life stages of malathion selected *Cx. quinquefasciatus* majority fell in the range of  $> 2.00$  i.e., beyond the resistance threshold. *Cx. quinquefasciatus* permethrin strain, indicated heterogenous resistant status throughout the 10 generations of selection. There is no correlation between the  $LC_{50}$  values of malathion and permethrin and non-specific esterases in larval stage of *Cx. quinquefasciatus*. The present study also exhibited no correlation between the resistance ratios of  $LT_{50}$  and mean esterase activity in female permethrin strain.

In *Ae. aegypti* selected strains, it was noted that only malathion selected strain exhibited homogenous susceptibility where the frequency absorbance was distributed below the resistance threshold for all the life stages tested. Meanwhile permethrin and temephos selected strains indicated heterogenous resistance status. Both the malathion and permethrin selected strains *Ae. aegypti*, the frequency of the replicates were all distributed below the resistance threshold and defined non-specific esterase was not associated in malathion and permethrin resistance in adult female of *Ae. aegypti*.

There is no correlation between LC<sub>50</sub> and non-specific mean esterase activity in larvae stages of *Ae. albopictus*. Both the malathion and permethrin selected *Ae. albopictus*, the frequency population of female replicates distributed below the resistance threshold and defined non-specific esterase was not associated in malathion and permethrin resistance in adult female of *Ae. albopictus*.

*Cx. quinquefasciatus* malathion and permethrin strains exhibited 4 distinct esterase bands. Female malathion selected *Cx. quinquefasciatus* showed heavily stained E1, E2 and E3 bands, but E3 was very heavily stained when compared to susceptible strain indicating that E3 could be responsible in the resistance mechanism due to malathion (OP).

*Ae. aegypti* selected strains revealed 6 bands labeled as E1, E2, E3, E4, E5 and E6. Interestingly, in all the different life stages band E5 was the common band in any stage tested for *Ae. aegypti*. All the selected strains of *Ae. aegypti* exhibited lightly stained esterase bands. . In overall, all the *Ae. aegypti* selected strains, the esterase activity in relation to the band intensity found to be in low level in all the developmental stages. Non-specific esterase not playing a role in resistance to malathion permethrin and temephos in *Ae. aegypti*..

Five regions of esterase bands were detected in *Ae. albopictus* named accordingly E1, E2, E3, E4 and E5. The presence of these bands were different from *Ae. aegypti* and *Cx. quinquefasciatus*, this is would be an evidence of the existence of species specific bands in *Ae. albopictus*. All the bands were lightly stained and this indicating non-specific esterase not playing a role in resistance to malathion permethrin and temephos in *Ae. aegypti*.