INTERNATIONAL POLICY BRIEF SERIES
Education and Science Journal of Policy Review and Curriculum Development
Volume 5 Number 2, May 2015.

SUSCEPTIBILITY STATUS OF CULEX QUINQUEFASCIATUS (SAY) TO DDT AND PROPOXUR IN GOMBE STATE

[1]Jacob, P., & [2]Yoriyo, K. P.
[1&2]*Department of Biological Science,*
Gombe State University, Gombe-Nigeria

Abstract
Mosquitoes are the most important insect that affects human health, especially the poor, who are more at risk of its bite hence making them sick. This work was aimed at determining the susceptibility status of culicine mosquitoes to two insecticides in the study area. A study on the susceptibility status of culicine to DDT (4%) and Propoxur (1.0%) in three (3) Local Government Areas of Gombe State was conducted over a period of three months (March-May 2010). A total of 750 culiciline mosquitoes were collected from their larval stage and reared to adult stage in an Insectary laboratory in Gombe State University. These were tested separately for each of the L.G.A's namely Akko, Gombe and Yamaltu-Deba using a Susceptibility test kits recommended by World Health Organization. Culex quinquefasciatus species shows (100%) susceptibility when expose to Propoxur in all the three (3) L.G.A's over a period of 1 hour exposure interval. No signs of resistance were noticed in Propoxur. Exposure to DDT showed a strong indication of resistance in all the study sites where Gombe LGA shows (57%), Yamaltu-Deba (34%) and Akko (22%) at 1 hour interval. This study reveals that Propoxur will be more suitable in the control ofCulex quinquefasciatus species in Indoor Residual Spraying (IRS) Activities compared to DDT. It is hoped that this knowledge will provide useful information on the best chemical to be used in the control of malaria and other mosquito-borne diseases by the Malaria Control Booster Programme Gombe State.

Keywords: *Culex, Susceptibility, DDT, Propoxur, Gombe*

Background to the Study

Mosquitoes are principal vector of many vector borne diseases affecting Human beings and other Animals (Betson *et al.*, 2009).Several mosquito species belonging to the genera *Anopheles, Aedes* and *Culex* are vectors of wide range of diseases: malaria, filariasis, Japanese encephalitis, dengue fever, west nile virus, yellow fever and chikungunya (WHO, 2008).

Little is known on the susceptibility of Mosquitoes in Sudan savanna to the spectrum of many and widely used insecticides in this area (Molta *et al.*,1990). The work of the World Health Organization in Kaduna, Kano and Sokoto states of Nigeria has paved way to this problem. With increase in the chemical pest control activities in the savannas, there may be the tendency for insecticides to develop resistance to the conventional product (Molta

http://internationalpolicybrief.org/journals/edu-and-science-journal-vol5-no2
ISSN PRINT: 2315-8425, ONLINE 2354-1660

et al., 1990). It is a priority to determine and monitor the efficacy of these chemicals as well as their effects on the ecosystem be monitored as part of the operation. Culicines are of interest to man as potential vectors of various pathogens such as yellow fever, filariasis, encephalitis (Annon, 1992). These disease vectors controlled by, using either insecticides treated nets (ITNs) or Indoor Residual Spraying (IRS), relies on the continued susceptibility of mosquitoes to a limited number of insecticides (WHO, 2003).

Effective implementation of indoor residual spraying with DDT or other recommended insecticides should be a central part of the national malaria and other mosquito borne disease control strategies (WHO, 2006). DDT has for long been the cheapest insecticides and the one with longest residual efficacy against *Anopheles* that transmit malaria and other mosquito-borne disease vector (6-12 month depending on dosage and substrate). Thus, the use of alternatives to DDT might require 2 or 4 spraying cycle per year instead of one depending on the length of transmission season (WHO, 2006). Other insecticides have relatively shorter residual effect: Pyrethroid requires 4-6 month; Organophosphate and Carbamates: 2-6 month (WHO, 2006).

Mosquito bite has been a major public health problem with malaria and L/filariasis as major diseases in Nigeria and Gombe state in particular. Vector control is an effective way of reducing malaria and other vector borne disease transmission. Little is known on the Susceptibility status of Mosquitoes to chemical insecticides in Gombe state. Synthetic chemicals employed in vector control are to ensure that it is effective, affordable, and environmentally friendly (WHO, 2005). The aim of this study was to determine the Susceptibility status of Culicine Mosquitoes to DDT and Propoxur in Gombe state with the hope that the information obtained will be useful to the State Malaria Control Booster Project for their planned Indoor Residual Spray (IRS) Activities.

Materials and Method

The study was carried out in Akko, Gombe and Yamaltu-Deba Local Government Areas of Gombe state. Gombe state has 11 Local Government areas located between latitude 9°30? to 12°30" North and Longitude 8°45" to 11° 45" east. It has a surface area of 20,265sq.km. The projected population of the state from the 2006 census is 2,657,246 people, National population commission (NPC, 2009). The vegetation of the area is savannah type. The major occupation of the people is farming and to some extends fishing.

Preliminary Investigation

A preliminary survey was carried out within the study areas to identify the breeding sites of mosquitoes. These areas were selected based on convenience.

Larval Collection

Mosquito larvae were collected from the identified breeding sites of the three Local Government Area namely; Akko, Gombe, Yamaltu-Deba LGAs. A ladle was used to collect different larval instars. A total of 7-10 scoops were collected depending on the abundance of the larvae in a particular breeding site in order to get enough quantity for rearing. Mosquito larvae were placed into a small plastic bowl covered with a net. All collected larvae were brought to the Insectary laboratory of Gombe State University where they were reared to adult stage in a (hatchery). The adult mosquito were transferred to a cage with the help of an Aspirator and fed for a day or two before the test was conducted according to the method of WHO, 2005.

Susceptibility Bioassay.

These principles exposes the insects to a given dose of insecticide for a given time to assess its susceptibility or otherwise (WHO, 2008). The mosquitoes were transferred from the cage with the help of an aspirator to the test kits of the two different insecticides DDT (4%) and Propoxur (1.0%). A total of 20-25 fed mosquitoes were introduced into five WHO holding tubes (four tests and one control experiment) the control tube contained

untreated papers whereas, the exposure tubes/test experiments contained the insecticide impregnated papers. Mortality rate was observed at 5, 10, 15, 20,30,40,50, 60 minute interval. After one hour exposure, mosquitoes were transferred back to holding tubes and were provided with food (cotton wools moisten with a 10% glucose solution) for 24 hours following the procedure of WHO, (2008).

Mortality rate was calculated by Abbot formula as:

Exposure mortality, E= $\left(\frac{number\ of\ dead\ mosquitoes}{total\ number\ of\ mosquitoes\ in\ tube\ with\ insecticides}\right) x\ 100$

Control mortality, C= $\left(\frac{number\ of\ dead\ mosquitoes}{total\ number\ of\ mosquitoes\ in\ control\ tube}\right) x\ 100$

If control mortality is = 5% and = 20% the value for exposure mortality E should be corrected by using (Abbott's formula):

Corrected exposure mortality (%) = $\left(\frac{E-C}{100-C}\right) x\ 100$

Where, E is the Exposure mortality and C, control mortality.

Results

A total number of 750 female *Culex quinquefaciatus* were exposed to impregnated insecticides treated papers with propoxur and DDT with control in each case. Table 1-3 shows results of *Culex quinquefaciatus* exposed to Propoxur in which within 30mins 45% were knockdown in Gombe and Yamaltu-Deba and 21% in Akko. Within an interval of one to 24hours intervals all the mosquitoes were killed in all the L.G.As giving a100% mortality rate. Table 4-6 shows the results of *Culex quinquefaciatus* exposed to DDT which shows a lower knockdown rate of mosquitoes compared to Propoxur. Gombe shows 11%, Yamaltu-Deba 4% and Akko 2% within 30mins exposure to DDT. Within 1hour the knockdown rate was: Gombe 54%, Yamaltu-Deba 34% and Akko 22%. Mortalities observed at 24hours interval shows that Gombe had (57%), Yamaltu-Deba (34%) and Akko (22%). The results shows that *Culex quinquefaciatus* are more susceptible to Propoxur than DDT.

Table 1: Knock downrate of *Culex quinquefaciatus* from Gombe L.G.A. exposed to Propoxur

Time (min)	Control (%)	Knock down (%)
5	0.0	0
10	0.0	3
20	0.0	22
30	0.0	45
40	0.0	58
50	1.0	82
60	1.0	100
24 hours	1.0	100

Table 2: Knock downrate of *Culex quinquefaciatus* from Yamaltu-Deba exposed to Propoxur.

Time (min)	Control (%)	Knock down (%)
5	0.0	0
10	0.0	0
20	0.0	10
30	0.0	45
40	0.0	64
50	0.0	87
60	0.0	100
24 hours	0.0	100

Table 3: Knock downrate of *Culex quinquefaciatus* Akko L.G.A. exposed to Propoxur.

Time (min)	Control (%)	Knock down (%)
5	0.0	0
10	0.0	4
20	0.0	8
30	0.0	21
40	0.0	37
50	0.0	61
60	0.0	100
24 hours	0.0	100

Table 4: Knock downrate of *Culex quinquefaciatus* from Gombe L.G.A. exposed to DDT

Time (min)	Control (%)	Knock down (%)
5	0.0	0
10	0.0	0
20	0.0	2
30	0.0	11
40	0.0	19
50	0.0	25
60	1.0	54
24 hours	1.0	57

Table 5: Knock downrate of *Culex quinquefaciatus* from Yamatu-Deba exposed to DDT

Time (min)	Control (%)	Knock down (%)
5	0.0	0
10	0.0	0
20	0.0	2
30	0.0	4
40	0.0	9
50	0.0	14
60	0.0	34
24 hours	0.0	34

Table 6: Knock downrate of *Culex quinquefaciatus* form Akko L.G.A exposed to DDT

Time (min)	Control (%)	Knock down (%)
5	0.0	0
10	0.0	0
20	0.0	2
30	0.0	2
40	0.0	5
50	0.0	11
60	0.0	22
24 hours	0.0	22

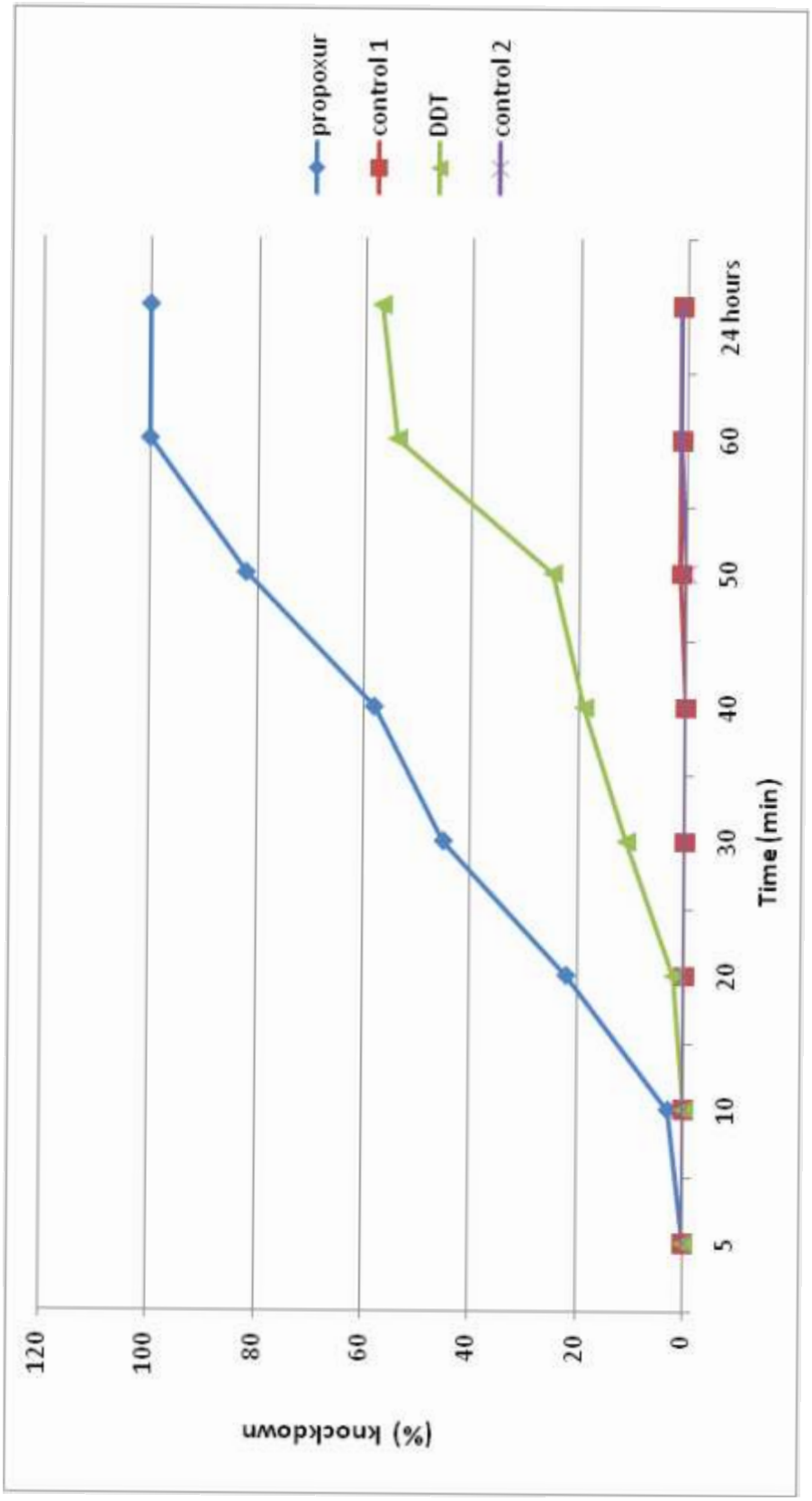

Fig. 1: knock down mortality rate of *Culex quinquefaciatus* from Gombe L.G.A. exposed to propoxur and DDT.

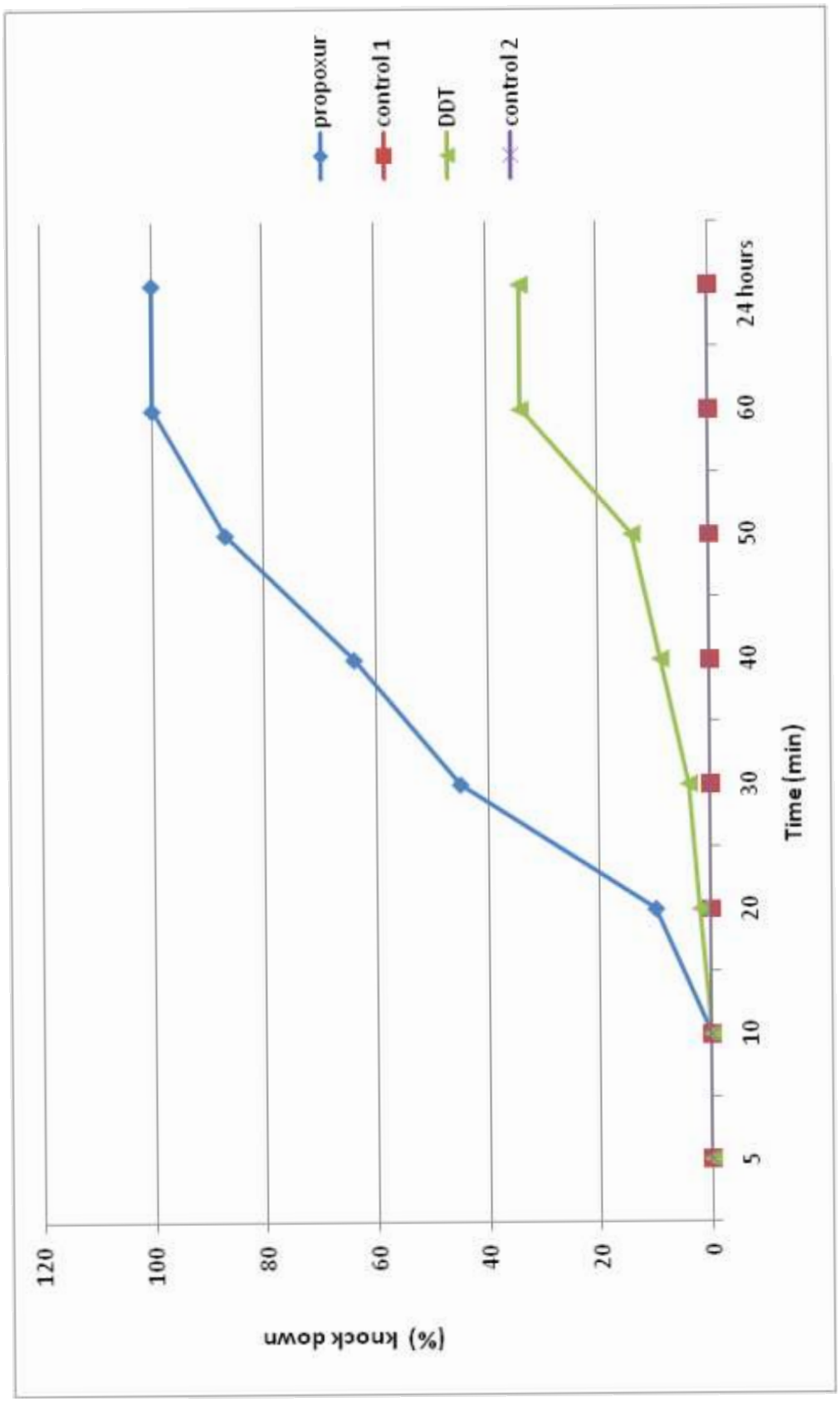

Fig. 2: knock down motality rate of *Culex quinquefaciatus* from Yamaltu-Deba L.G.A. exposed to propoxur and DDT.

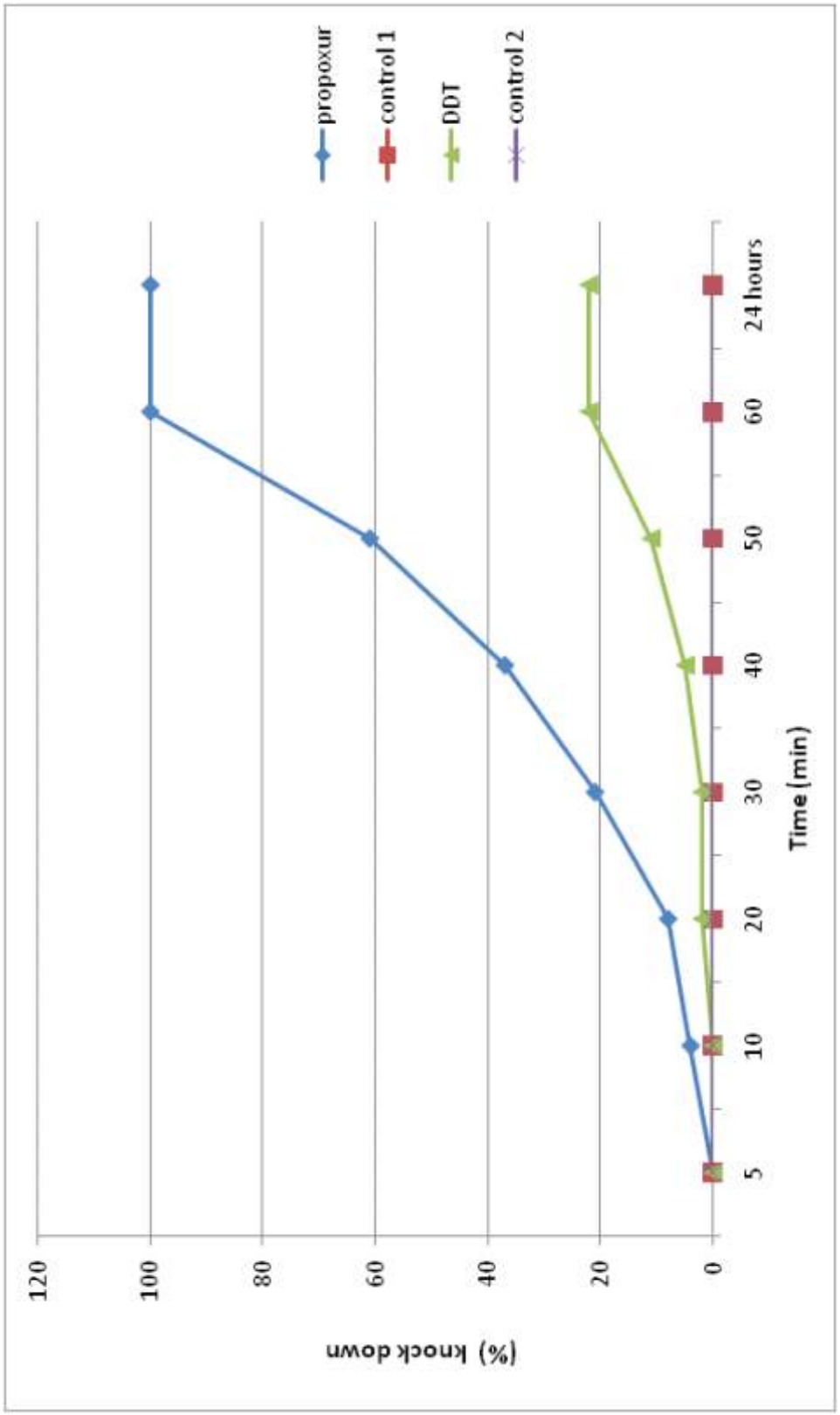

Fig. 3: knock down motality rate of *Culex quinquefaciatus* from Akko L.G.A. exposed to Propoxur and DDT.

Discussion

Many insecticides of the group organochlorine (DDT), Organophosphate (Fenthion, Malathion and Temphos) and Pyrethroids (Permethrin, Deltamethrin, Lambda cyhalothrin e.t.c) have been used in malaria control programmes and for other mosquito control management. Checking the susceptibility status is a good indicator for the early detection of resistance (WHO, 2008).

This study has shown high knock down mortality rate of culicine mosquitoes exposed to Propoxur which was found in all the 3 L.G.As with 100% susceptibility at 60 minutes intervals. This agrees with the work of World Health Organization (WHO, 2003) which reported a 98% susceptibility status to Propoxur insecticides in Gambia. According to (WHO, 2001) recommendations. (98-100%) mosquito mortality indicate susceptibility, (80-97%) suggest potential resistance that needs to be confirmed,(<80%) mortality suggest resistance.

A very slow knock down mortality of culicine mosquitoes exposed to DDT impregnated papers from all the L.G.As were recorded. This ranges from 22-57%. Gombe with (57%), Yamaltu-deba (34%) and Akko (22%). This agrees with the reported resistance of culicine mosquitoes to DDT in Gambia (Betson *et al.*, 2009).

The findings of this study show that culicine mosquitoes from the three localities were susceptible to propoxur as 100% mortality was recorded after 24hours post exposure period indicating full susceptibility, whereas resistance to DDT was also suspected in all the three localities. Resistance shown here may be as a result of continued use of chemicals in farmlands such as herbicides, fungicides, germicides and insecticides (Rogan and Chen, 2005). These chemicals tend to remain in the soil/environment for months to several years and these mosquitoes become resistance to them. There is a need for continued surveillance to find out the resistance factors present in these mosquito species.

References

Abbot, W.S, (1925), "A Method for Computing the Effectiveness of an Insecticide". Journal of Economical Entomology. 18:265-267

Annon, C.W., (1992), "Diseases of Mosquito Vector species of the Tropics". Bulleting of Entomology society of New Zealand. 10:20-30.

Betson, M., Musa, J., Taiwo, S., (2009). Status of insecticides susceptibility in Anopheles gambiae from malaria surveillance sites in Gambia. Malaria Journal. 96:849-860

Goma, L.K., (1961), The mosquito. Published by Hutchinson tropical Monographs, Hutchinson & Co. ltd. 38: 176-202

Molta, N.B., Gadzama, N.M., Standsfield, F., (1990): The susceptibility of a Mosquito species (Culex pipiens quinquefasciatus) to the insecticides, Malathion, DDT, & DBMT in the Sudan Savanna zone of Nigeria. Nigerian Journal of Entomology.11: 43-52

National Population Commission, (2009). Gombe State Census.

Rogan, W.J., & Chen, A., (2005). Health Risk & Benefits of DDT. The Lancet. 366: 763-773

Winterbourn, M.J., Gregson, K.L., Dolphin, C.H., (2000), "Guide to aquatic Insect of New Zealand". Bulleting of Entomology Society of New Zealand. 76: 67-89.

World Health Organization, (2001), “Use of indoor residual spraying for Scaling up global malaria control & Elimination”. Geneva.

World Health Organization, (2003), “Safe use of pesticides”. WHO Technical Report Series. Geneva.

World Health Organization Pesticides Evaluation Scheme (2005), “Safety of Pyrethroids for Public Health use”. WHO pesticide evaluation scheme. 5: 23-102

World Health Organization, (2006), “Use of Indoor Residual Spraying for Scaling up Global Malaria Control & Elimination. Geneva.

World Health Organization (2002), “Test procedures for insecticides Resistance monitoring in malaria vectors”. Bio-efficacy & persistence of Insecticides on Treated Surfaces”. WHO. 98: 20-31.

World Health Organization (2008): susceptibility & Bioassay tests. Geneva