

THE EFFECTIVENESS AND RESIDUAL EFFECT OF VECTOBAC TABLETS, VECTOBAC WG AND TEMEPHOS IN CONTROLLING *Aedes aegypti* LARVAE IN EARTHEN WATER JARS

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EFEKTIVITAS DAN EFEK RESIDU DARI TABLET VECTOBAC, VECTOBAC WG DAN TEMEPHOS DALAM PEMBERANTASAN LARVA *Aedes aegypti* DI GENTONG AIR

Abstrak. Penelitian dilakukan menggunakan *Bacillus thuringiensis* formulasi tablet dan granula seperti VectoBac tablet, VectoBac WG dan Temephos 1% SG untuk pengendalian larva nyamuk *Aedes aegypti* pada tempat penampungan air terbuat dari tanah (gentong) di desa Kemalang, Kabupaten Klaten, Jawa Tengah. Tujuan penelitian untuk evaluasi efektivitas dan efek residu VectoBac tablet, VectoBac WG and Temephos 1% SG pada gentong terhadap jentik *Ae. aegypti*. Evaluasi insektisida dilakukan terhadap empat perlakuan; 1) gentong diisi 50 liter air hujan, digunakan untuk keperluan rumah tangga dan tidak dilakukan penggantian air yang telah digunakan setiap hari, 2) gentong diisi 50 liter air hujan, digunakan untuk keperluan rumah tangga dan dilakukan penggantian air yang telah digunakan setiap hari (volume dijaga tetap 50 liter), 3) gentong diisi 50 liter air hujan, tidak digunakan untuk keperluan rumah tangga (5 liter air diganti setiap hari), 4) gentong diisi 50 liter air hujan, tidak digunakan untuk keperluan rumah tangga (5 liter air diganti setiap dua hari). Hasil penelitian menunjukkan bahwa efektivitas VectoBac tablet dan VectoBac WG pada 4 perlakuan terhadap kematian jentik *Ae. aegypti* sampai dibawah 70% berturut-turut adalah 7-9 minggu dan 15 sampai 17 minggu. Efek residu Temephos 1% SG (semua perlakuan) masih menunjukkan kematian jentik *Ae. aegypti* 100% pada evaluasi 17 minggu.

Key words: Efektivitas; *Bacillus thuringiensis* Bti; *Aedes aegypti*.

INTRODUCTION

Chemical control against *Aedes aegypti* larvae (vector of Dengue Haemorrhagic Fever/DHF) has been conducted using Temephos 1% SG (Organophosphate Compound). In some areas of Yogyakarta Province, Indonesia, this species became tolerant to Temephos and reported less than 70% mortality^(1,2,3). Due to increasing numbers of resistant mosquitoes species and the limited choice of alternative insecticides currently in use, several microbial insecticides are presently under development. Some are now ready for implementation in operational programmes. Most progress has been made with the biological

control agent *Bacillus thuringiensis* H-14. This agent was proven to be highly effective in the field against mosquito larvae and are now commercially available. In laboratory and field trials, (applied at the rates required to mosquitoes control), *B. thuringiensis*, is very safe for the majority of aquatic non-target organisms.

The efficacy of *Bacillus thuringiensis israelensis* (Bti tablet formulation namely Culinex T (KABS Germany product) has been evaluated against *Ae. aegypti* larvae in the field, at Ambarawa Sub District, Semarang District, Central Java Province, Indonesia. Various water containers (plastic, earthen water jars, etc.) were treated with

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Culicid T (10 ppm concentration). Water was used by the inhabitant for regular purposes and the efficacy was reported 5 weeks⁽⁴⁾.

The objective of the study was to evaluate the effectiveness of *Bacillus thuringiensis* (VectoBac Tablets and VectoBac WG) and Temephos 1% SG in controlling *Ae. aegypti* larvae in water containers (earthen water jars) and establish the residual effect larval control.

MATERIALS AND METHODS

Study area:

The study was conducted in Kemalang village, Klaten District, Central Java province, Indonesia, for 4 months period (February – May, 2002). People commonly are using stored rain water for daily activities, because of lack of water resources (wells or springs) in the area. Earthen water containers (60 litres volume) were used in the study, for holding portable rain water (for cooking and drinking).

Materials:

1. *Bacillus thuringiensis* (VectoBac Tablets and VectoBac WG)
2. Temephos 1% SG (Abate)
3. Earthen water jars
4. *Aedes aegypti* larvae 2nd instar
5. Trays, buckets, plastic cups, pipettes and torchlight

Treatment:

- a. VectoBac tablet (1 tablet/50 liters water)
- b. VectoBac WG (0.5 g/50 liters water)
- c. Abate (Temephos) 1% SG (5 g/50 liters water)
- d. Untreated Control (UTC)

Test design :

A total of 80 containers (earthen water jars) were provided and distributed to 20

selected houses (4 containers each), and water usage (treated) as follows:

- A. Five earthen water jars were filled with 50 liters of rain water, used as a regular source of household water (volume of water depends on the household daily activities and was not daily maintained at 50 litres).
- B. Five earthen water jars were filled with 50 liters of rain water, used as a regular source of household (water was daily maintained at 50 litres).
- C. Five earthen water jars were filled with 50 liters of rain water, used as water storage (water was not used as regular source and five liters were daily replaced with new water).
- D. Five earthen water jars were filled with 50 liters of rain water, used as water storage (not used as regular source of household water). Every two days, the volume of water was maintained for 50 liters (due to leakage and evaporation).

Treatment Code

- I. Earthen water jars (containers) marked orange (5 replications)
W1: Treated of VectoBac Tablet (1 tablet/50 liters water)
W1A : Treated container **W1** and water usage **A**
W1B : Treated container **W1** and water usage **B**
W1C : Treated container **W1** and water usage **C**
W1D : Treated container **W1** and water usage **D**
- II. Earthen water jars (containers) marked blue (5 replications)
W2 : Treated of VectoBac WG (0.5 g/50 liters water)
W2A : Treated container **W2** and water usage **A**

W2B : Treated container **W2** and water usage **B**

W2C : Treated container **W2** and water usage **C**

W2D : Treated container **W2** and water usage **D**

III. Earthen water jars (containers) marked red (5 replications)

W3 : Treated of Temephos 1% SG (5 g/50 liters water)

W3A : Treated container **W3** and water usage **A**

W3B : Treated container **W3** and water usage **B**

W3C : Treated container **W3** and water usage **C**

W3D : Treated container **W3** and water usage **D**

IV. Untreated earthen water jars (containers) marked white (5 replications)

W4 : Untreated/control of earthen water jars (containers)

W4A : Treated container **W4** and water usage **A**

W4B : Treated container **W4** and water usage **B**

W4C : Treated container **W4** and water usage **C**

W4D : Treated container **W4** and water usage **D**

Application :

- One week prior to treatment, earthen jars were filled with 50 liters of stored rain water and *Ae. aegypti* larvae (laboratory colony) were used for evaluation.

Evaluation :

Weekly evaluation was conducted in 5 days, as follows :

1. 1st (Monday):

- Twenty five *Ae. aegypti* larvae (laboratory colony), 2nd instar, were introduced

in each treated and untreated earthen water jars.

2. Following 4 days (2nd, 3rd, 4th, 5th day).

- Daily evaluation, the larval mortality was counted.

- Apart from *Ae. aegypti* larvae, other species were found in the water containers e.g. Anophelinae and Culicinae (introduced species). All introduced life larvae collected in the treated and un-treated earthen water jars were reared to adults and used for other evaluation.

Data Analysis :

Mean numbers of larval mortality was calculated for each container/sample day. Analysis of Variance (AOV) was performed on the data for treatment replicates to determine the significance of data. The Duncan multiple test was used for analysis of larval mortalities among the treatments.

RESULTS

The effectiveness (WHO standard,⁽⁵⁾ 70% mortality) of VectoBac tablets and Vecto Bac WG tested against *Ae. aegypti* larvae in all water jars were respectively 10-12 weeks and 15 to more than 17 weeks. Mortality of *Ae. aegypti* larvae in all water jars treated with Temephos 1% SG at 17 weeks after treatment was 100% (Figures 1-7). Average volume of water daily used by inhabitants or evaporated during the trial was 11.80-15.50 litres (A&B) and 0.40-2.30 litres (C &D) (Table 1). There were different efficacy and residual effects of VectoBac tablets and VectoBac WG in the jars, where water used and not used for daily regular household purposes. Anophelinae and Culicinae larvae collected in the earthen water jars treated with VectoBac tablets, were reared to adults (Table 2).

DISCUSSION

AOV and Duncan multiple test of 5 weeks evaluation of *Ae. aegypti* larvae mortality in all treated containers and various water used by inhabitants, were not significantly different ($p>0.05$) (Table 3). Mortalities of *Ae. aegypti* larvae in the treated containers of VectoBac WG and

Temephos 1% SG on six weeks evaluation were 100% (Figure 5). Larval mortalities in the containers W1B, W2A and W3D were significantly different $p<0.05$, and other treatments W1A, W1B, W1C and W1D, were showed no significant difference ($p>0.05$) (Table 3).

Table 1. Average Daily Water Usage in Earthen Water Jars During The Trial.

Treatment	Average daily water usage / evaporated for each water container (liters)			
	A	B	C	D
VectoBac Tablets (W1-) (1 tablet/50 litres water)	12.20	13.60	1.80	1.80
VectoBac WG (W2-) (0.5 g/50 litres water)	13.60	14.20	2.20	2.30
Temephos 1% SG (W3-) (5 g/50 litres water)	12.80	11.80	1.80	1.50
Untreated Control (W4-)	15.50	13.50	0.40	1.50

Table 2. Other Species Larvae Collected in The Earthen Water Jars Treated With VectoBac Tablets (1 tablet/50 litres of water)

Evaluation Week	Genus <i>Anopheles</i> #				Genus <i>Culex</i> #			
	A	B	C	D	A	B	C	D
XV	2 (0)	1 (0)	2 (0)	0 (0)	1 (0)	0 (0)	0 (0)	0 (0)
XVI	5 (0)	8 (0)	1 (0)	1 (0)	0 (0)	1 (0)	0(0)	0 (0)
XVII	4 (0)	6 (0)	4 (0)	3 (0)	2 (0)	4 (0)	3 (0)	3 (0)

In the brackets: larval mortality after 24 hours holding

Treatment of earthen water jars :

- A. The earthen jars were used as a regular source of household water, volume of water depend on the household activities, (NOT daily maintained for 50 liters),
- B. The earthen jars were used as a regular source of household water, volume of water (daily maintained for 50 liters),
- C. The earthen jars were usage as water storage, NOT used as a regular source of household water (five liters of water were daily replaced with new water).
- D. The earthen jars were usage as water storage (NOT used as a regular source water), every two days, the volume of water was maintained for 50 liters.

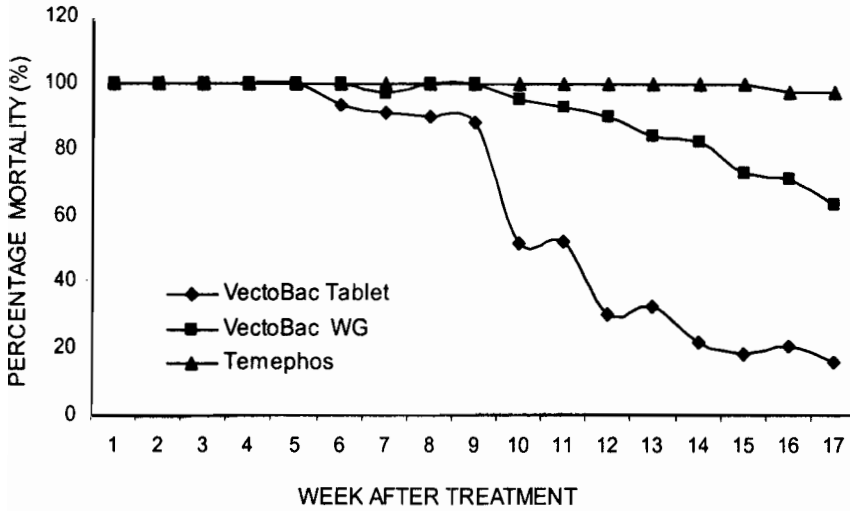


Figure 1. Percentage Larval Mortality of *Ae. aegypti*, in 5 Earthen Jars (filled with rain water). The Jars Were Used as a Regular Source of Household Water, (Volume Depends on The Activities, Not Daily Maintained for 50 liters)

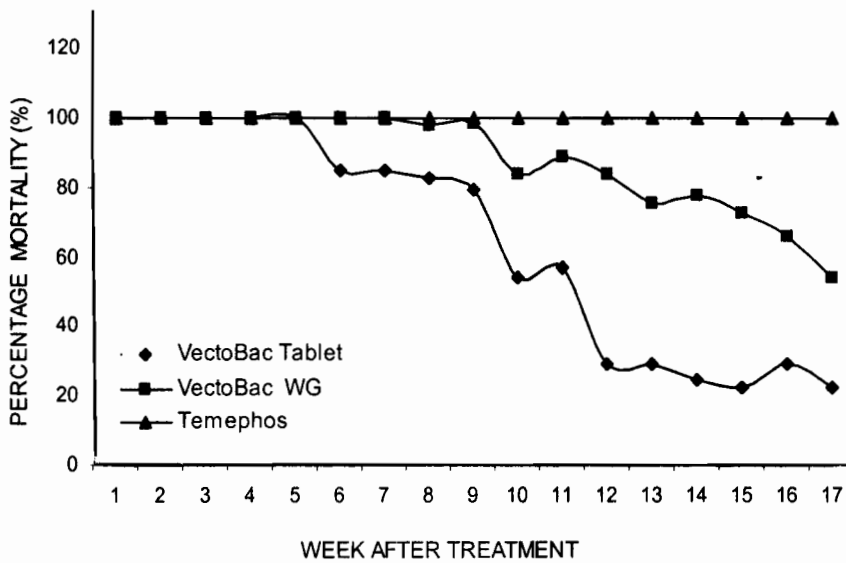


Figure 2. Percentage Larval Mortality of *Ae. aegypti*, in 5 Earthen Jars (Filled With Rain Water). The Jars Were Used as A Regular Source of House Hold Water (Volume Was Daily Maintained for 50 Liters)

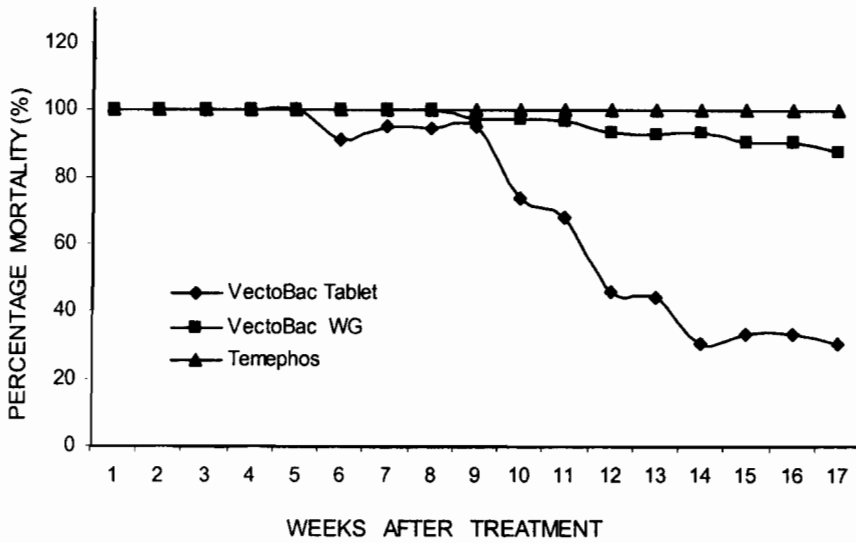


Figure 3. Percentage Larval Mortality of *Ae. aegypti*, in The 5 Earthen Jars (Filled With Rain Water). The Jars Were Used as Water Storage, Not Used as A Regular Source of Household Water (5 Liters of Water Were Daily Replaced With New Water),

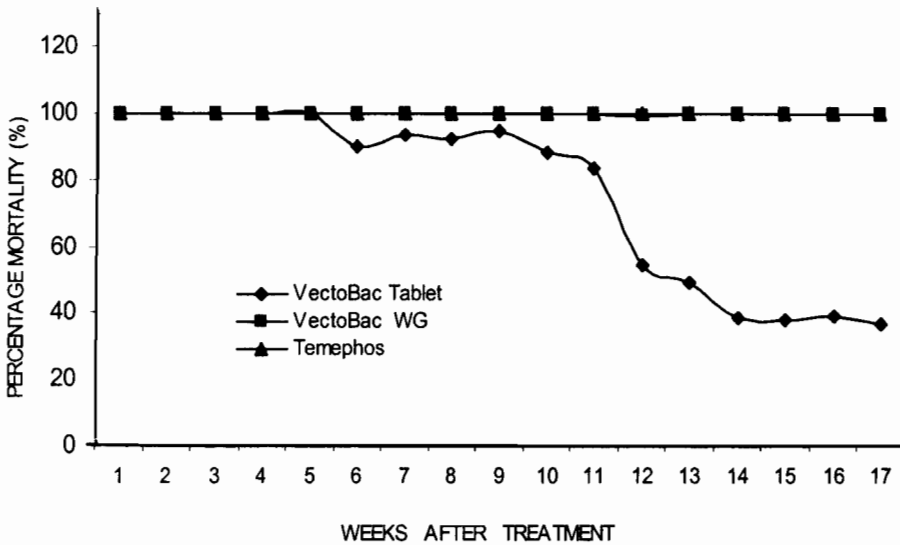


Figure 4. Percentage Larval Mortality of *Ae. aegypti*, in The 5 Earthen Water Jars (Filled With Rain Water). The Jars Were Used as Water Storage (Not Used as Regular Source of House Hold Water), Every Two Days The Volume Of Water Was Maintained for 50 Liters

Seven weeks evaluation, indicated that mortalities of *Ae. aegypti* larvae in the containers W1A and W1B (treated of Vecto Bac 1 tablet/50 litres), were significantly different with: W1C, W1D, W2A, W2B, W2C, W2D, W3A, W3B, W3C, W3D ($p < 0.05$) (Table 3). Evaluation 8 weeks after treatment revealed that average mortalities of *Ae. aegypti* larvae in all treated earthen water jars with VectoBac tablets and VectoBac WG were 82.40–94.40% and 97.60–100%, respectively (Figures.5 & 6). Larval mortalities of other treatments remained 100% (Figure. 7). Mortality of *Ae. aegypti* larvae in the container W1B on eight weeks evaluation, showed significant difference with: W2A, W2B, W2C, W2D, W3A, W3B, W3C, W3D ($p < 0.05$) and no significantly different with W1A, W1C and W1D ($p > 0.05$) (Table 3).

Nine weeks evaluation, showed that larval mortalities in the containers W1A and W1B (treated with VectoBac 1 tablet/ 50 litres) were significantly different with: W1C, W1D, W2A, W2B, W2C, W2D, W3A, W3B, W3C and W3D ($p < 0.05$) (Table 3). Larval mortality in the container W1A on ten weeks evaluation showed a significant difference with: W1C, W2A, W2B, W2C, W2D, W3A, W3B, W3C, W3D ($p < 0.05$) and no significant difference with W1B ($p > 0.05$) (Table 3).

Eleven weeks evaluation indicated that mortality of *Ae. aegypti* larvae in the container W1A, was significantly different to : W1D, W2A, W2B, W2C, W2D, W3A, W3B, W3C, W3D ($p < 0.05$) and showed no significant difference with W1B and W1C ($p > 0.05$) (Table. 3). Mortality of *Ae. aegypti* larvae in the container W1B at 12 weeks evaluation showed a significant difference with: W1D, W2A, W2B, W2C, W2D, W3A, W3B, W3C, W3D and no significant difference with W1A and W1C ($p > 0.05$). Thirteen weeks evaluation

indicated that mortality of *Ae. aegypti* larvae in the container W1B, was significantly different to: W1C, W1D, W2A, W2B, W2C, W2D, W3A, W3B, W3C, W3D ($p < 0.05$) and no significant difference with W1A ($p > 0.05$) (Table. 3).

In the earthen water jar W1A, mortality of *Ae. aegypti* larvae on fourteen weeks after treatment showed a significant difference with W1D, W2A, W2B, W2C, W2D, W3A, W3B, W3C and W3D ($p < 0.05$). The results also indicated that W1D, was significantly different with W2A, W2B, W2C, W2D, W3A, W3B, W3C and W3D ($p < 0.05$). Larval mortalities in the treated containers W1A, W2C, W3A, W3B, W3C and W3D, showed no significant difference ($p > 0.05$) (Table 3).

Fifteen weeks evaluation showed that larval mortality in the earthen water jar W1A, was significantly different to W1D, W2A, W2B, W2C, W2D, W3A, W3B, W3C and W3D ($p < 0.05$). The results also indicated that larval mortality in the earthen water jar W1D, was significantly different with W2A, W2B, W2C, W2D, W3A, W3B, W3C, W3D ($p < 0.05$). In the treated containers: W1A, W1B, W1C and W2C, W2D, W3A, W3B, W3C, W3D showed that larval mortalities were not significantly different ($p > 0.05$) (Table 3).

Sixteen weeks evaluation showed that larval mortality in the earthen water jar W1A, was significantly different to W1D, W2A, W2B, W2C, W2D, W3A, W3B, W3C and W3D ($p < 0.05$). The results also indicated that mortality of *Ae. aegypti* larvae in the earthen water jar W1D, was significantly different to W2A, W2B, W2C, W2D, W3A, W3B, W3C and W3D ($p < 0.05$). The average larval mortalities in the treated containers: W1A, W1B, W1C and W2A, W2C, W2D, W3A, W3B, W3C, W3D showed no significant difference ($p > 0.05$) (Table 3).

Table 3. Duncan Test of Percentage Larval Mortality on Five to Seventeen Weeks After Treatment

Treatment	Tot#	Week After Treatment *												
		5	6	7	8	9	10	11	12	13	14	15	16	17
W1A	125	100.0a	93.6ab	91.2ab	89.6ab	88.0ab	51.2a	52.0a	30.4a	32.8a	21.6a	18.4a	20.8a	16.0a
W1B	125	100.0a	84.8a	84.8a	82.4a	79.2a	54.4ab	56.8a	28.8ab	28.8ab	24.8a	22.4ab	28.8ab	22.4ab
W1C	125	100.0a	91.2ab	95.2bc	94.4b	95.2bc	73.6bc	68.0ab	45.6ab	44.0bc	30.4ab	33.6ab	33.6ab	30.4bc
W1D	125	100.0a	89.6ab	93.6bc	92.0ab	94.4bc	88.0bc	83.2be	54.4ab	48.8c	38.4b	37.6b	39.2b	36.8c
W2A	125	100.0a	100.0b	96.8c	100.0b	100.0c	95.2c	92.8c	89.6c	84.0de	82.4cd	72.8c	71.2c	63.2d
W2B	125	100.0a	100.0b	100.0c	97.6b	98.4c	84.0bc	88.8c	84.0c	75.2d	77.6c	72.8cd	65.6c	54.4d
W2C	125	100.0a	100.0b	100.0c	100.0b	97.6c	97.6c	96.8c	93.6c	92.8ef	93.6de	90.4de	90.4d	88.0e
W2D	125	100.0a	100.0b	100.0c	100.0b	100.0c	100.0c	100.0c	100.0c	100.0f	100.0e	100.0e	100.0d	100.0e
W3A	125	100.0a	100.0b	100.0c	100.0b	100.0c	100.0c	100.0c	100.0c	100.0f	100.0e	100.0e	97.6d	97.6e
W3B	125	100.0a	100.0b	100.0c	100.0b	100.0c	100.0c	100.0c	100.0c	100.0f	100.0e	100.0e	100.0d	100.0e
W3C	125	100.0a	100.0b	100.0c	100.0b	100.0c	100.0c	100.0c	100.0c	100.0f	100.0e	100.0e	100.0d	100.0e
W3D	125	100.0a	100.0b	100.0c	100.0b	100.0c	100.0c	100.0c	100.0c	100.0f	100.0e	100.0e	100.0d	100.0e
Sig.		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		

Total of treated larvae for 5 replications (25 larvae for each treated earthen water jar)

* Weekly percentage larval mortality followed by same letter, were not significantly different.

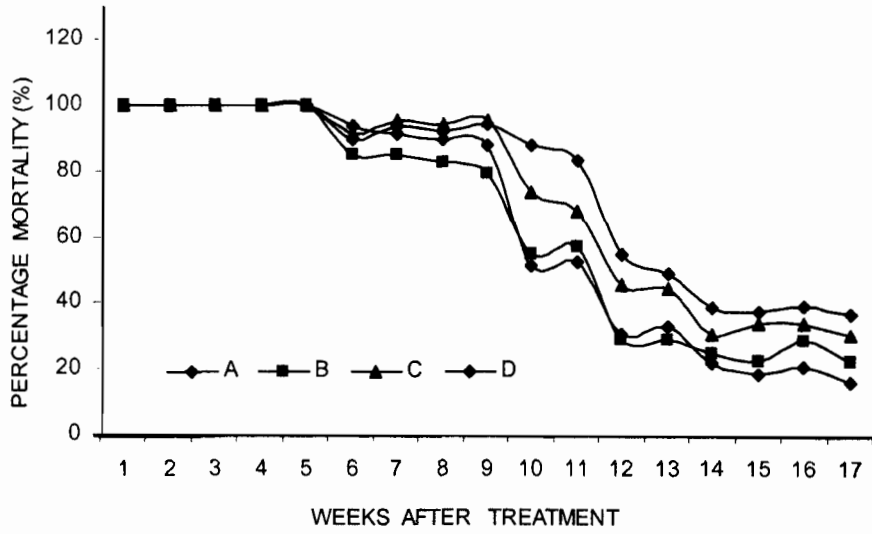


Figure 5. Percentage Larval Mortality of *Ae. aegypti*, in The Earthen Water Jars (Filled With Rain Water), Treated With VectoBac Tablets (1 Tablet/50 Ltrs Water)

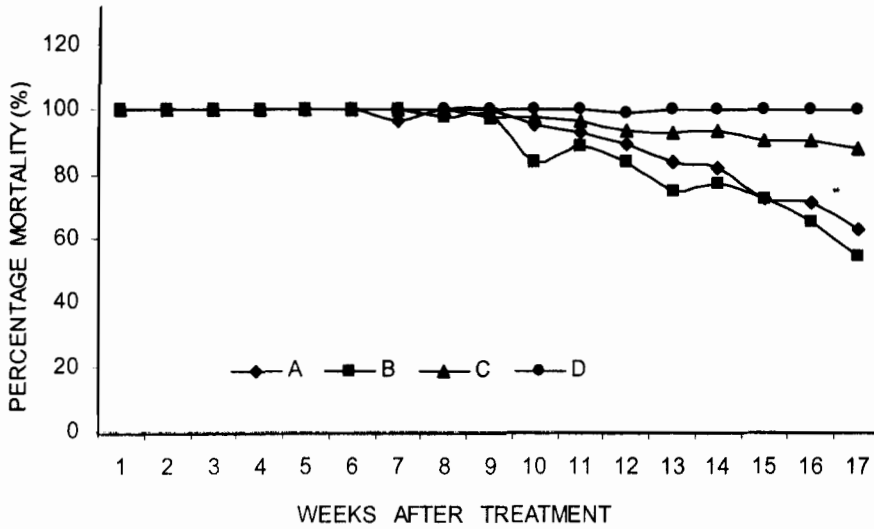


Figure 6. Percentage Larval Mortality of *Ae. aegypti*, in The Earthen Water Jars (Filled With Rain Water), Treated With VectoBac WG (0.5 g/50 Liters Water)

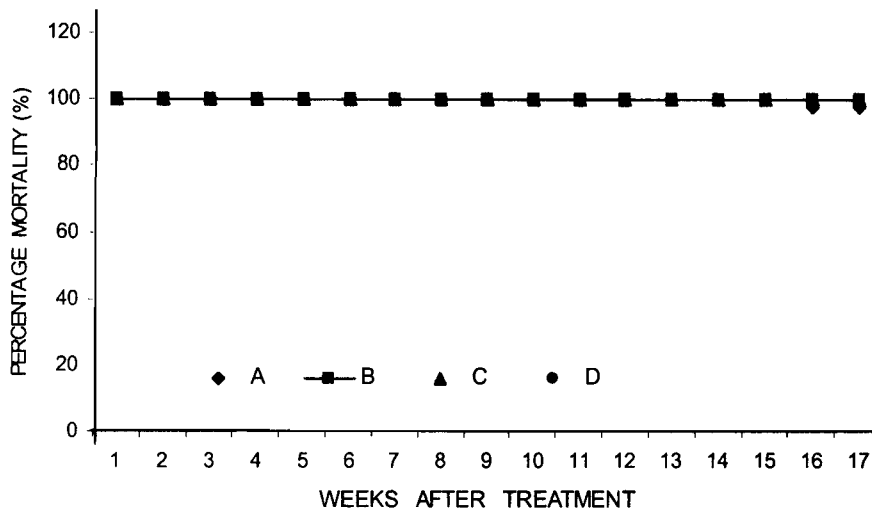


Figure 7. Percentage Larval Mortality of *Ae. aegypti*, in The Earthen Water Jars (Filled With Rain Water) Treated With Temephos 1% SG (5 g/50 Liters Water)

Treatment of earthen water jars :

- A. The earthen jars were used as a regular source of household water, volume of water depend on the household activities, (NOT daily maintained for 50 liters),
- B. The earthen jars were used as a regular source of household water, volume of water (daily maintained for 50 liters),
- C. The earthen jars were used as water storage, NOT used as a regular source of household water (five liters of water were daily replaced with new water).
- D. The earthen jars were used as water storage (NOT used as a regular source water), every two days, the volume of water was maintained for 50 liters.

Larval mortality in the earthen jar W1A on seventeen weeks evaluation showed significantly different with W1C, W1D, W2A, W2B, W2C, W2D, W3A, W3B, W3C and W3D ($p < 0.05$). Mortality of *Ae. aegypti* larvae in the earthen water jar W1D was significantly different with W2A, W2B, W2C, W2D, W3A, W3B, W3C and W3D ($p < 0.05$). In the container W2A was significantly different with W2C, W2D, W3A, W3B, W3C, and W3D ($p < 0.05$). No significant difference of larval mortalities in the treated containers W1A

and W1B; W2B and W2A; W1B and W1C; W2C and W2D, W3A, W3B, W3C , W3D ($p > 0.05$) (Table 3). The efficacy of *Bti* tablet Culinex T (KABS Germany product) in various water containers plastic, earthen water jars, (10 ppm concentration), was reported 5 weeks⁽⁴⁾.

Anophelinae and Culicinae larvae collected in the earthen water jars treated with VectoBac tablets, were reared to adults (Table. 2). Results indicated that efficacy of VectoBac tablets (1 tablet/50 litres water)

was 7-9 weeks. Average volume of water daily used by inhabitants or evaporated during the trial were 11.80-15.50 liters (treated containers A&B) and 0.40-2.30 litres (treated containers C &D) (Table. 1).

In conclusion, the effectiveness and residual effect in all water jars of: 1) VectoBac tablets for A, B, C and D treatments were (7-9 weeks), 2) VectoBac WG for A and B treatments (15-16 weeks), for C and D treatments more than 17 weeks, 3) Temephos 1% SG for all treatments at 17 weeks were 100%. The residual effect of VectoBac tablets and VectoBac WG in the jars, where water was used or not used for daily regular household purposes, were significantly different.

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