ABSTRACT
Aim: This study was conducted in order to confirm the presence and establishment of Aedes (Stegomyia) albopictus (Skuse, 1894) and provide information about its distribution during the period of July to October 2012 in Salfit district (Northwestern West Bank).

Study Design: A cross-sectional study.

Methods: A cross-sectional survey was conducted in West Bank - Salfit district to collect larvae and adults of the Aedes albopictus mosquito from two localities in Salfit district during the period of July to October 2012.

Results: Adult Aedes albopictus mosquitoes were found and collected from outdoor sites of different habitats in two localities in Salfit district for the first time (Mas-ha and AZ-Zawia locality) and different immature stages (larvae and pupae) of mosquito were found in one locality in Salfit district (Mas-ha locality).

Limitations of Study: This study discusses the presence and distribution of Aedes albopictus in Salfit district during the period of July to October 2012.

Conclusion: The results show that the dense populations of adults and larvae were found in the subsequent survey, confirming the establishment of the species in the area. More studies are needed to understand the ecology and biology of Aedes albopictus and its distribution in Salfit district and its possibility of transmitting viral diseases.

Keywords: Aedes albopictus; Salfit district; presence; distribution.
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1. Introduction:

The mosquito *Aedes* (Stegomyia) *albopictus* (Skuse, 1894), known notoriously as the Asian Tiger Mosquito, has been spreading worldwide during the past two decades and has been reported in more than 25 countries on the five continents outside its natural region since the end of 1970 (1, 2). It was originally widespread in South Asia and on the Islands of the Western Pacific and Indian oceans (3). In recent decades it has also spread to North and South America, Australia, New Zealand, Africa and European countries such as France, Italy and Spain (4-6) It can also be found in Mediterranean region countries such as Lebanon, Syria and Israel, which is nearest to the West Bank within few kilometers distance (7,8).

*Ae. albopictus* are easily recognized by the bold black shiny scales and distinct silver white scales on the palpus and tarsi (9). The scutum (back) is black with a distinguishing white stripe down the center beginning at the dorsal surface of the head and continuing along the thorax (9). It is a highly invasive mosquito species and difficult to control, it is also aggressive in the day-time, and considered a container breeder preferring to oviposition in small quantities of water such as drums, tires, buckets, flower saucers, tarpaulins and manholes and tree holes (4, 5,10).

In addition to the nuisance of biting and according to the existing literature *Ae. albopictus* possesses a potential threat to human health. It has been experimentally infected with more than 20 arboviruses (11, 12). It is known to be a vector of several arboviruses in Africa, Asia and Europe. Many studies have proved that the *Ae. albopictus* is the main vector for dengue, Chikungunya (CHIK) and Encephalitis viruses (1, 11, 12), and was recently found naturally infected with West Nile virus in the U.S.A (13).

In the Mediterranean region the presence of *Ae. albopictus* in different countries such as Lebanon, Syria, and Israel, including studies in its ecology, biology and its medical importance in transmitting diseases has been documented (7, 8, 14). Recently Palestine- West Bank Ministry of Health reported that a new species of mosquito (*Ae. albopictus*) was found in a few sporadic foci in different districts of the West Bank. However details and studies concerning the presence of *Ae. albopictus*, including its biology, ecology, distribution and its medical importance of this species in Palestine – West Bank have never been recorded (15). This is the first report provides information of the presence, establishment, distribution and breeding sites of *Ae. albopictus* mosquito in West Bank.
2. Material and Methods:

2.1. Study area:

Salfit district located at 32° 7' 5.5" N, 35° 5' 25" E (figure. 1) with total area is almost 202 sq km, is one of 17 districts of the Palestinian National Authority. It is located in the northwestern West Bank, bordered by the district of Ramallah and Al-Bireh to the South, Nablus to the East, and Qalqilya to the North as well as Israel to the West. According to the Palestinian Central Bureau of Statistics (PCBS), 2007 the governorate has a population of 59,570 inhabitants. Mas-ha and AZ-Zawia localities located in the Western part of Salfit district and have total population 5200 inhabitants most of whom work in agriculture and trade. Economic activity depends on agriculture, where olives, almonds, figs, grapes, and apples are the main crops. It has a hot climate, dry summers and rainy winters, and has the average maximum temperature 29 ºC, while the average minimum temperature amounts to 6 ºC. The average humidity in the region is 62% that may rise up to 67%. Rainfall is concentrated in the winter and the average rainfall is 660 mm per year.

2.2. Sampling sites:

The study was conducted to collect larvae and adults of suspected Ae. albopictus mosquito from two localities in Salfit district namely Mas-ha locality and Az-Zawia locality.

2.3. Study design:

This study was conducted as a cross sectional survey to collect larvae and adults of suspected Ae. albopictus mosquito from two localities in Salfit district namely Mas-ha locality and Az-Zawia locality from July 2012 until October 2012. The two sites were selected based on the continuous complaints from the residents who suffered from an aggressive mosquito biting during the daytime that has colors (black and white) and were not noticed before this year in these localities. Every study site at first was divided into sectors of different habitats using the simple random technique (vegetation areas, animal areas and waterside areas), then larvae and adults mosquito were collected from outdoor sites of the two localities using different collection methods described below.

2.3.1. Larva and adult collection and identification:

Larva collection:

Mosquito larvae were collected from all available potential breeding sites. (Tin cans, discarded tires, plastic and metal container waters, etc.). Dipping technique was used in the collection {16}. Larvae were transported to the laboratory, and washed and killed with hot water and kept in 70% alcohol then mounted on slides using Euparal {16}.

Adult collection:

Only adult mosquitoes of suspected Ae. albopictus were collected from the positive localities of different habitats by using landing catches on volunteers during the day using an aspirator apparatus and conserved with funnel test tube until identification in the laboratory. Other species of mosquito were neglected.

Adults and larvae identification:

Collected adult and larva mosquitoes were sent to the lab at Salfit Primary healthcare center for identification and identified by using morphological keys (17-19).

2.4. Distribution of Ae. albopictus adults and larvae in different habitats of the study areas

To investigate the presence of Ae. albopictus adults and larvae in different habitats, each study site is divided into three sectors, where each sector represents a different habitat (1- animal and poultry farm, or any areas using for rearing animal 2- vegetation cover such as house gardens, plant farms and nurseries, etc. 3- waterside such as outside artificial wells irrigation canals, artificial pools and any other source of water), then Ae. albopictus adults and larvae were collected from these habitats during the
study period and numbers of *Ae. albopictus* adults and larvae collected from each sector of the sites were recorded and analyzed.

### 2.5 Data management and analysis

Data were entered in SPSS software 16 and analyzed using. Simple descriptive statistics,

![Map of the West Bank](image)

Figure 1. Shows the located of Mas-ha (M) and Az-Zawia (Az) localities in Salfit district in the West Bank (Palestine Central Bureau of statistic, 2007)
3. RESULTS:

3.1. Collecting adults and larvae of *Ae. albopictus* from outdoor sites in Mas-ha and Az-Zawia localities during the year 2012.

Only suspected *Aedes albopictus* adults were collected and other mosquitos were neglected. The total of 200 adult *Aedes albopictus* mosquitoes were collected from outdoor sites in two localities in the Salfit district (150 adults from Mas-ha locality and 50 adults from Az-Zawia locality). All mosquitoes were identified as *Aedes albopictus* (Table 1). 590 different immature stages (550 larvae and 40 pupae) of mosquitos were also collected. Only larvae were identified. The results show that (300;60%) of larvae were *Ae. albopictus* and found in one locality in the Salfit district (Mas-ha locality) as shown in Table 1.

3.2. Distribution of *Ae. albopictus* adult and larva in different habitats in Mas-ha and Az-Zawia localities in Salfit district during the year 2012

During the period of entomological survey, 120 outdoor sites of vegetated area in Mas-ha and AZ-Zawia localities were inspected for suspected adults and larvae of *Ae. albopictus* mosquito. The results show that (31;26%) of positive site have adults or larvae of *Ae. albopictus*, The results show (17; 48%) of inspecting outdoor sites of water areas in Mas-ha localities have positive adults and larvae of *Ae. albopictus* mosquito. No positive site for larva and adult *Ae. albopictus* was found in the animal area in two localities as shown in Table 2.

3.3. Breeding sites of *Ae. albopictus* in Mas-ha and Az-Zawia localities in Salfit district during the year 2012

The total number of possible breeding sites inspected for *Ae. albopictus* larvae were 511 of different breeding sites, the results show that the breeding sites for immature stages were only one (0.44%) plastic containers of water (200L) used for plant irrigation in nursery as shown in table 3.
Table 1. Number of adults and larvae of *Ae. albopictus* collected outdoor sites from Mas-ha and AZ-Zawia localities in Salfit district for the year 2012

<table>
<thead>
<tr>
<th>Localities</th>
<th>NO of adults <em>Aedes albopictus</em> collected</th>
<th>NO of larvae collected</th>
<th>NO of positive <em>Aedes albopictus</em> larva collected</th>
<th>% of positive <em>Aedes albopictus</em> larva collected</th>
<th>NO of pupae collected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mas-ha</td>
<td>150</td>
<td>500</td>
<td>300</td>
<td>60</td>
<td>27</td>
</tr>
<tr>
<td>AZ-Zawia</td>
<td>50</td>
<td>50</td>
<td>0</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>150</td>
<td>550</td>
<td>300</td>
<td>55</td>
<td>40</td>
</tr>
</tbody>
</table>

Table 2. Numbers and percentages of positive inspected outdoor sites for immature stages and adults of *Ae. albopictus* in Mas-ha and AZ-Zawia localities in Salfit district for the year 2012

<table>
<thead>
<tr>
<th>Localities</th>
<th>No of inspecting outdoor sites of vegetated area</th>
<th>No of positive inspection outdoor sites of vegetated area</th>
<th>% of positive inspection outdoor sites of vegetated area</th>
<th>No of inspecting outdoor sites of animal area</th>
<th>No of positive inspection outdoor sites of animal area</th>
<th>% of positive inspection outdoor sites of animal area</th>
<th>No of inspecting outdoor sites of water area</th>
<th>No of positive inspection outdoor sites of water area</th>
<th>% of positive inspection outdoor sites of water area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mas-ha</td>
<td>100</td>
<td>30</td>
<td>(30;100)=(30)</td>
<td>30</td>
<td>0</td>
<td>0</td>
<td>35</td>
<td>17</td>
<td>(17;35)=(48)</td>
</tr>
<tr>
<td>AZ-Zawia</td>
<td>20</td>
<td>1</td>
<td>(1;20)=(5)</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>120</td>
<td>31</td>
<td>(31;120)=26</td>
<td>40</td>
<td>0</td>
<td>0</td>
<td>43</td>
<td>17</td>
<td>(17;43)=(4)</td>
</tr>
</tbody>
</table>
Table 3. Shows the most types of inspecting breeding sites of *Ae. albopictus* and the percentage of positive breeding sites in Mas-ha and AZ-Zawia localities in Salfit district

<table>
<thead>
<tr>
<th>Type of possible breeding sites inspected</th>
<th>No of possible breeding site inspected</th>
<th>No of positive possible breeding site inspected</th>
<th>% of positive breeding site inspected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discarded tires</td>
<td>30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Tree holes</td>
<td>45</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Tin cans</td>
<td>55</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Plastic containers</td>
<td>227</td>
<td>1</td>
<td>1/227=(0.44)</td>
</tr>
<tr>
<td>Metal containers</td>
<td>23</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Flower saucers</td>
<td>8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Pot of plants</td>
<td>43</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Artificial wells</td>
<td>50</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Others</td>
<td>30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>511</td>
<td>1</td>
<td>1/511=(0.2)</td>
</tr>
</tbody>
</table>

Other : Any container possible to collect water outdoor site

4. Discussion:

*Ae. albopictus* is a widespread mosquito and it plays a role in transmitting diseases in neighboring countries such as Syria, Lebanon, and Israel [7, 8, 14]. Many studies discussed the presence, distribution, biology, ecology and medical importance of this species especially in Israel that is a country close to Palestine which shares borders in all districts, so the transmission of *Ae. albopictus* to Palestine - West Bank is possible by different ways. It can be transported in vehicles, trading ornamental plants, trees (fruits, citrus, etc.) or other methods. These means are suitable habitat for breeding and resting of *Ae. albopictus*. This hypothesis agrees with different studies like [7, 20], which suggests that the *Aedes albopictus* was transmitted by vehicle transportation. Mandon et al. 2002, 2004 found that the immature stages of mosquito were transmitted by ornamental plant and trees sent to California and the Netherlands.

In Salfit district especially in Mas-ha and Az-Zawi locality it is expected that the presence of *Ae. albopictus* is due to the previous methods, but the transporting or trading of ornamental plants is thought to be the more likely way. Through the entomological survey the results showed that all places having positive *Ae. albopictus* Adults mosquitoes have ornamental plants (flowers) brought from the nurseries located in the neighboring country (Israel) which endemic with *Ae. albopictus*. The results also showed the presence of immature stages of mosquito in one place (nursery) in Mas-ha locality from salfit district. Through the investigations with the owner of this nursery, the results showed that all plants (ornamental plants, trees plant) were coming from endemic areas in Israel. This result agrees with other studies as [21-23], which proved that immature stages of mosquito transmitted through the trading of ornamental plants coming from an endemic country with *Ae. albopictus*.

5. Conclusion:
The results show that the dense populations of adults and larvae were found in the subsequent survey, confirming the establishment of the species in the area. More studies are needed to understand the ecology and biology of *Ae. albopictus* and its distribution in Salfit district and its possibility of transmitting viral diseases.

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**COMPETING INTERESTS**

Author has declared that no competing interests exist.

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15. MOH, Palestinian Health Information Center, Dengue not recorded in Palestine. 24/08/2012. Website, WWW. MOH.PS