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Original Research Article

Presence of the Asian tiger mosquito *Aedes (Stegomyia) albopictus* (Skuse, 1894) (Diptera: Culicidae) in the city of Tizi-Ouzou (Algeria Northern)

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ABSTRACT:
The presence of the Asian tiger mosquito Aedes (Stegomyia) albopictus (Skuse, 1894) in a given region is a major problem, because this mosquito is known for its nuisance and transmission of infectious diseases. In Algeria, this species was first detected in Tizi-Ouzou in 2010 and again in 2014 in rural areas. After this, no study has reported its presence and no complaints about its nuisance were reported in this region. A monitoring of the presence of Ae. albopictus in the city of Tizi-Ouzou was carried out for three years. In 2021 we found adults belonging to this mosquito. In the present work we report this first detection in the city of Tizi-Ouzou, this appearance shows its strong capacity to colonise new territories.

Keywords: *The Asian tiger mosquito, Aedes albopictus, Monitoring, Tizi-Ouzou city, Algeria.*

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INTRODUCTION

Invasive Culicidae species are defined by their capacity to colonise new territories and to be likely to cause damage of economic, environmental and health importance (Schaffner *et al*., 2013). The Asian tiger mosquito *Aedes albopictus*, native to Southeast Asia (Rúa-Uribe *et al*., 2012., Cunze *et al*., 2016), has now invaded many parts of the world (Neteler *et al*., 2013). It is an invasive mosquito that is highly damaging to humans and its global distribution is largely determined by accelerated urbanisation, connectivity and climate change (Kraemer *et al*., 2019). According to Bouree *et al*. (2015), the distribution area of this species has expanded rapidly with the means of transport and in particular the storage of tyres. Global warming is likely to be a further factor in the spread of the disease. This wide distribution has contributed to the increase in its vectorial role (Rezza, 2012). A change in the geographical distribution of mosquitoes is currently accompanied by a re-emergence of infectious diseases (Bawin *et al.,* 2014). The species can transmit several viruses that cause serious human diseases (Wang *et al*., 2021), in particular Dengue, Chikungunya (Delaunay *et al*., 2009), Yellow fever and Zika fever (Bouree *et al*., 2015., Ducheyne *et al*., 2018). Under natural conditions, this species is capable of

transmitting three Flaviviruses (Dengue, West Nile and Japanese Encephalitis), six Bunyaviruses (Jamestown Canyon, Keystone, La Crosse, Potosi, Cache Valley and Tensaw) and one Alphavirus (Eastern Equine encephalitis) (Bocková, 2013).

In southern Europe, *Aedes albopictus* has recently been implicated as the vector of the first indigenous cases of Dengue and Chikungunya (Kaufmann *et al*., 2014), it was first reported in Albania in 1979, in Germany in 2007 by Pluskota *et al*. (2008), in Malta in 2009 by Gatt *et al*. (2009). It was introduced into North America in 1972 (Darriet, 2015). In the Middle East, *Ae. albopictus* has been found in Lebanon and Syria by Haddad *et al*. (2007), Palestine in 2012 by Adawi (2012) and Jordan in 2016 by Kanani *et al*. (2017). Its presence in North Africa is a major concern (Chahed *et al*., 2021a), it was found in Algeria in 2010 (Izri *et al*., 2011), Morocco in 2015 (Amraoui *et al*., 2019) and Tunisia in 2018 (Bouattour *et al*., 2019).

In Algeria, this mosquito has invaded many regions including, Algiers (Benallal *et al*., 2019), Annaba (Arroussi *et al*., 2021), Jijel and Skikda (Chahed *et al*., 2021b) and Souk Ahras (Hamaidia & Soltani., 2021), its nuisance in the cities of these regions is very significant.

In the city of Tizi-Ouzou, no complaints about its nuisance were reported, Lounaci *et al*. (2016) did not find this species in their study and Chahed *et al*. (2021a) reported the absence of this species in their survey. Nevertheless, its presence in Algeria was first reported in a rural areas by Izri *et al*. (2011) in Larbaâ Nath Irathen, followed by Lafri *et al.* (2014) in Illoula Oumalou, which led us to investigate several locations in the city of Tizi-Ouzou to confirm its invasion.

MATERIALS AND METHODS

Study area

Tizi-Ouzou is located in Algeria Northern (36°42'49''N / 4°02'48"E, altitude 190m), it is bounded to the North by the Mediterranean basin. It is considered to be Csa (Warm Temperature, Dry and Hot Summer) according to Köppen *et al*. (2011). The geographical location of the study area is shown in the figure 1.

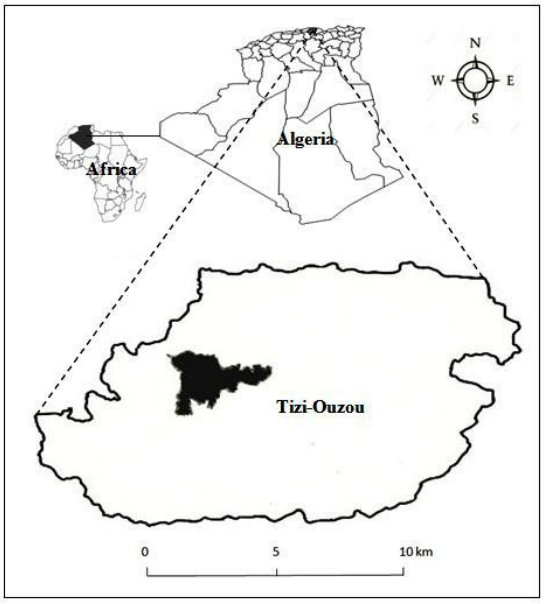

Figure 1: **Geographical location of the study area.**

Sampling

Monitoring of the Asian tiger mosquito invasion in the city of Tizi-Ouzou has been carried out for the years 2019, 2020 and 2021, we placed 10 larvae traps in several locations in this area, the traps were placed under trees in shady places rich in vegetation, they are shown in figure 2. In June 01, 2021, an adult

female of *Aedes albopictus* was captured on human bait in a house located in the town of Tizi-Ouzou, following which sampling procedures were put in place to capture the adults at rest and on human bait using dry tubes.

Figure 2: **Traps placed in the field (© S. Chahed)**

Identification

The collected specimens were frozen and then transported to the Laboratory of Ecology and Biology of Terrestrial Ecosystems at the University of Mouloud Mammeri of Tizi-Ouzou for identification, the latter consisting of determining morphological criteria of the adults and examination of the male genitalia using the Keys of Becker *et al*. (2010). Confirmation of our identification was done based on the latest version of the MosKeyTool identification software of Günay *et al*. (2020).

RESULTS

A total of five adults of *Ae. albopictus* was collected, represented by four females and one male, the sub-imaginal stages were not found in the traps placed in the field. Two adult were captured on human bait in a house located in the city of Tizi-Ouzou (New town) named 1, two others were captured at rest at the University Mouloud Mammeri of Tizi-Ouzou in two sites named 2 and 3. One adult was captured in an open space in New town named 4. These results are clarified in figure 3 and Table 1.

Figure 3: **Geographical location of the catch points using Google earth, 2021.**

Table 1: Location of *Aedes albopictus* collected during the survey

Collection site	Coordinates	Elevation	Collection date	Capture on human body/at rest
1	36°41'34''N / 4°03'10''E	158m	June 01, and August 21, 2021	2 females
2	36°41'46''N / 4°03'26''E	148m	June 10, 2021	1 female
3	36°41'47''N / 4°03'28''E	140m	July 07, 2021	1 male
4	36°41'39''N / 4°03'01''E	142m	August 23, 2021	1 female
Total				1 male, 4 females

Figure 4: *Aedes albopictus* Adult captured in the city of Tizi-Ouzou in 2021 (© S. Chahed).

Figure 5: Male genitalia (© S. Chahed)

The species is characterised by legs with white stripes and a mesothorax with a longitudinal white line, these criteria are clarified in figure 4. The examination of the male genitalia is clarified in figure 5.

DISCUSSIONS

This occurrence can be explained by the presence of a high human density in the city of the study area and especially in the capture sites, which increased the possibility of introducing this species by citizens, according to Ducheyne *et al*. (2018), the availability of the host plays a very important role for the presence of this species in a given location.

The detection of *Ae. albopictus* in the urban environment of the study area can also be explained by the preference of this species for artificial breeding sites. According to Becker *et al*. (2010), urban areas provide an ideal habitat for many species of mosquitoes, with abundant availability of the blood meal and according to Almeida *et al*. (2020), anthropogenic environments offer favourable conditions for certain species, notably mosquitoes. It can also be explained by the presence of very abundant vegetation in the collection sites.

By surveying the study area, we noticed the presence of villas with gardens and swimming pools near the collection sites, according to Benallal *et al.* (2019), trees and villas offer favourable conditions for the reproduction of this species. This may be a cause for the introduction of this species in this area. Nevertheless, the main causes of this occurrence remain poorly known.

The absence of larvae in this study can be explained by the fact that this species is in the installation phase in the urban environment and its numbers are still low to colonise any artificial breeding site.

The presence of *Ae. albopictus* in the city of Tizi-Ouzou is a real concern, it needs further research to understand the main causes of invasion and to demonstrate its seasonal dynamics. In addition, research on its vectorial role needs to be conducted as this species can transmit diseases. So far, the vectorial role of this species in Algeria is limited, but with climate change, the risk of disease spread should not be neglected.

CONCLUSION

We report by this present work the first detection of *Aedes albopictus* in the city of Tizi-Ouzou, this appearance shows its strong capacity to colonise new territories. This work could be used in awareness campaigns for the citizens of this region.

Conflict of Interest

The authors declare that they have no conflicts of interest.

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