

Asian Mosquito Tiger: a nuisance, threat or both?

Tanya Melillo MD MSc(HSM) Dip (HSM)

Consultant in Public Health
Head of Infectious Disease Prevention and Control Unit
Department of Health Promotion and Disease Prevention, Msida
Email: tanya.melillo@gov.mt

Educational aims

- To identify diseases caused by the Asian Mosquito Tiger
- To highlight methods of preventing bites
- To familiarise with ways of minimising mosquito proliferation

Key words

Mosquito, Asian Mosquito Tiger, mosquito borne diseases, Dengue, Chikungunya

Abstract

Asian Mosquito Tiger or *Aedes Aldopictus* is a mosquito which reached the Maltese Islands towards the end of summer of 2009 and has since spread and proliferated all over Malta and Gozo. It is a nuisance because of its ferocious biting on humans but it can also be a carrier of a number of diseases which may eventually be introduced to our islands causing outbreaks and resulting in a negative impact on our tourism and jeopardizing agricultural development resulting in major economic consequences.

The local situation

In the beginning of September 2009, Dr Paul Gatt, an entomologist, discovered the first *Aedes (stregomyia) Aldopictus (Skuse)* mosquito (*Insecta Diptera Culicidae*) in Malta in Mellieha.¹ The presence of this mosquito in Malta added to the total mosquito fauna documented in Malta, which now incorporates all of the subfamily *Culicinae*.^{2,3} The *Aedes Aldopictus*, popularly known as the Asian Mosquito Tiger originated from the forests of Southeast Asia where it was found to breed mainly in rotting tree holes.⁴ It was first described by Skuse (1984)⁵ in India but has since found its way all over the world due to its ability to breed successfully in both natural and artificial habitats since it requires only a small amount of water to breed.

A second record of the same species was confirmed by Dr J Buhagiar during the period of September and October of the same year in Marsasala.⁶ With two sightings in two different localities of the same mosquito which was previously never documented, the likely conclusion was that this mosquito had finally reached our shores during the summer of 2009.

Both Gatt and Buhagiar postulated that the likely mode of how this mosquito reached our shores was from Italy due to the large amount of sea traffic and close proximity between Italy/Sicily and Malta. On a daily basis, the Malta Freeport acts as a transshipment centre in the Mediterranean where large volumes of containers arrive, in addition there is a daily ferry link between Malta and Sicily, where there is a large flow of vehicles, both private and commercial which cross over between May and November, a large number of cruise liners touring the Mediterranean, stop for a day at Valletta Grand Harbour. The *Aedes Aldopictus* mosquito inhabits large parts of Italy and Sicily and Italy is in fact the country most infested with this mosquito in all of Europe.^{1,6,10}

During the winter of 2009/2010, surveillance was conducted to investigate the mosquitoes' presence and behaviour following its discovery and to see whether the species would survive our winter.⁷ Larvae and pupae were found to develop in the ovitraps throughout the winter and a few adult mosquitoes were also observed.

The results obtained from this surveillance confirmed that Malta had the ideal climate conditions during the winter months to allow the mosquito to develop

both in the egg and larvae stage with the development of the adult form once Spring arrives.⁷

A steering committee between the Infectious Disease Prevention and Control unit (ICDU) and the Institute of Earth Systems within the University of Malta was set up to develop a strategy for the surveillance of *Aedes Aldpoictus* in Malta.

The insect's distribution on the Maltese islands since reaching our shores was monitored throughout a whole year from September 2010 up to September 2011 using ovitraps placed in potential introduction sites and within localities that harbour potential habitats for the species. The Maltese islands were geographically split into 7 regions and ovitraps were placed in each region.

Every week they were checked for eggs and larvae. Scientific data was gathered from the ovitraps placed. The results following a full year monitoring showed that the mosquito proliferated and spread across all of Malta and was found in all regions except Gozo, but was then confirmed in December 2011. These results were also confirmed by reporting of public sightings during the same year whereby the general public was asked to provide information to IDCU if they were bitten by the mosquito and to also provide specimens of the mosquito when possible.⁹

The Asian Mosquito Tiger

It is a striking mosquito approximately 2-10mm in length, characterised by its black and white striped legs and small black and white body. The head consisting of eyes and a pair of long segmented antennae, is responsible for receiving sensory information and for feeding. The antennae's role is used to detect host odours.

It typically flies and feeds during the daytime unlike other mosquitoes. *Aedes albopictus* feeding peaks in the early morning

Figure 1: Adult Asian Tiger Mosquito, *Aedes albopictus* (Skuse).

Photograph: J.L. Castner, University of Florida



(dawn) and late afternoon (dusk). It is an opportunistic and aggressive biter with a wide host range including man, domestic and wild animals.¹⁰ Since it has a short flight range (around 200m), it tends to remain close to its breeding site. The male has a short life expectancy but the female can live from 3 weeks to 3 months. Water is the essential element for mosquito development because the female lays her eggs just above the surface of the water.^{11,12}

Life cycle

The female mosquito, after birth, looks for a male to mate. Mating occurs soon after emergence during a swarm flight. Once this is done, which only occurs once in their life, the female looks for a blood meal which is necessary to fertilise its eggs. About four or five days after feeding on blood, the female mosquito lays her eggs just above the surface of standing water.

Around 150 to 250 eggs are laid per oviposition (egg-laying event). Each female can have 1 to 4 ovipositions. When rain covers the eggs with water, the larvae hatch. The active reproductive period occurs from late Spring (May) to early Autumn (October).^{10,12}

Eggs are laid singly on the sides of water-holding containers such as tyres, animal watering dishes, birdbaths, flowerpots and natural holes in vegetation.¹⁰ They are black and oval with a length of 0.5 mm. Eggs can withstand desiccation for up to one year.

Larval emergence occurs after rainfall raises the water level in the containers. The eggs may require several submersions before hatching. Larvae development takes 3-8

Figure 2: Adult Asian Tiger Mosquito, *Aedes albopictus* (Skuse).

Photograph: Michele M. Cutwa, University of Florida

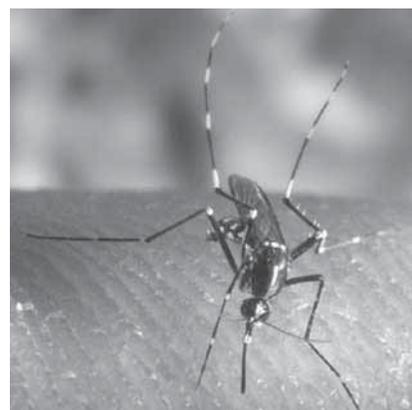
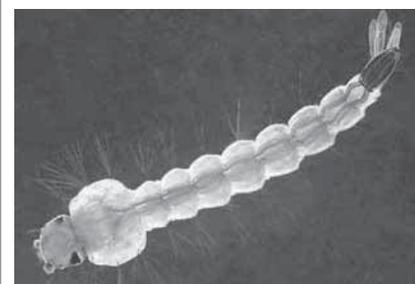


Figure 3: Larva of the Asian Tiger Mosquito, *Aedes albopictus* (Skuse).

Photograph: Michele M. Cutwa, University of Florida



weeks and adults can live for a period of 3 weeks to 3 months.^{10,13}

Asian Tiger Mosquitoes spend the winter in the egg stage, hatching into larvae when the eggs get covered with water in the spring. The larvae feed on small bits of debris and bacteria in the water. Its life cycle is closely associated with human habitat, and it breeds in containers with standing water.¹⁴

Asian Tiger Mosquitoes are known to be attracted to carbon dioxide, dark clothing, perspiration, and particular odours.¹⁴

Female mosquitoes hunt their blood host by detecting organic substances such as carbon dioxide and 1-octenol-3-ol produced from the host. Some persons are preferred to others by mosquitoes and that is why some are bitten while others are not. This is due to the smells produced by the victim's sweat which attracts the mosquito because of the proportions of carbon dioxide, octenol and other compounds that make up body odor.²⁸

Medical significance

Aedes albopictus is a known competent vector for at least 22 Arboviruses.¹⁵ These include Dengue, Chikungunya, West Nile fever, Yellow fever and Japanese Encephalitis. It can also transmit *Dirofilaria* to dogs. In order for the mosquito to be able to transmit infections, it has to be carrying the pathogen within itself first and then through biting its host, it transmits the virus, causing the host to develop the viral illness.

The two most likely viral illnesses transmitted by *Aedes Aldopictus* within the Mediterranean region are:

- Chikungunya
- Dengue

Chikungunya virus is a member of the genus alphavirus. It is spread by the bite of an infected mosquito. The incubation period is between 2-12 days but usually occurs within 3-7 days. It can cause a debilitating illness and is characterised by fever, headache, fatigue, nausea, vomiting, muscle pain, rash and joint pain. Acute Chikungunya fever can last from a few days to a few weeks but some patients have prolonged fatigue or develop incapacitating joint pains or arthritis which lasts for weeks or months.¹⁶

Dengue is an acute febrile viral disease caused by Flavivirus serotypes. It presents with sudden fever for 2-7 days together with two or more of the following: intense headache, retro-orbital pain, myalgia, arthralgia, rash or haemorrhage manifestation. Anorexia, nausea, vomiting and persistent abdominal pain may also be present.

Some patients with dengue fever go on to develop a severe and sometimes fatal form of the disease called Dengue Haemorrhagic Fever. This is characterised by a fever and evidence of haemorrhagic manifestations. The symptoms of infection usually begin 4-7 days post being bitten and last between 3-10 days.¹⁷

Ways to prevent being bitten

- Minimise the time spent outdoors between dawn and dusk when the mosquito is most active.
- Be sure that doors and windows have screens fitted tightly.
- Where possible wear socks, shoes, long trousers and long sleeved shirts when outdoors for long periods of time. Clothing should be made of tightly woven materials to keep the mosquitoes away from the skin.
- Use mosquito netting when sleeping outdoors and to protect infants in prams, pushchairs when outdoors.
- When it is necessary to be outdoors, apply insect repellent as indicated on the product's label. The more DEET (N,N-diethyl-m-toluamide) a product contains, the longer the repellent can protect against bites. However, concentrations higher than 50 percent do not increase the length of protection. For most situations, 10 -20% DEET is adequate. Apply to clothes when possible, and sparingly to exposed skin if the label permits. Consult a physician before using repellents on young children.

- Use fans as mosquitoes are weak fliers and a strong wind produced by a fan not only keeps them from away but diffuses chemical cues they use to locate blood meals.
- Note that insect light traps ("bug zappers") or sound devices do little to reduce the number of biting mosquitoes in an area.
- Spraying your backyard with an insecticidal fog or mist is effective only for a short time. Mosquitoes will return when the spray dissipates.¹⁸

Ways to control mosquitoes

All mosquitoes need water in order to reproduce. Each female mosquito may lay as many as 200 eggs that will transform into larvae and then into adults.

Therefore the control of these mosquitoes should be aimed at destroying the places where they lay their eggs which are never far from where people are being bitten.

- Remove all water filled containers like flower pots, old buckets, food containers and tires.
- Keep mosquitoes from breeding in bird's baths, pet water dishes and paddling pools by emptying them at least every 3 days.
- Any puddles, inlets to sewers and drainage systems should be drained not to allow water to stagnate for more than 3 days.
- Gutters should be kept clean from fallen leaves and other debris so that water does not collect in them.
- Man made outdoor features especially fish ponds should contain fish like gold fish, carp or killifish as these feed on the mosquito's immature stages.
- Litter can also hold rain water and should be removed.
- Any standing water in catchment basins etc that cannot be drained must be regularly treated with properly labelled insecticides.
- Always place a tight lid on containers used for water storage like water tanks. In cases where fish cannot be kept in open water reservoirs or wells, they need to be covered.
- Swimming pools must be maintained with regular chlorine or emptied if not in use.
- Do not leave toys in the garden which can store rain water
- Protect boats and vehicles from rain with tarps that do not accumulate water.^{19, 20}

Treatment when bitten

Once bitten, the clinical manifestation is characterised by an area of erythema around the bite, pruritus and moderate to extensive swelling of the area. This is largely due to a local chemical cellulitis rather than hypersensitivity caused by the contact of the mosquito's saliva with human skin.

It is recommended that a cold compress is applied initially followed by an antiseptic cream. Oral antihistamines should be given and if gross swelling is present, topical and/or oral corticosteroid might be indicated following specialist advice. Antibiotics should not be prescribed as the bites are not infected. If evidence of secondary bacterial infections develops characterised by pain, tenderness, pus and an extension of the erythema beyond the bite, then an oral antibiotic primarily aimed against *staph aureus* and *strep.pyogenes* should be given. Topical antibiotics should be avoided.²¹

Conclusion

The Asian Mosquito Tiger will use almost any container that holds enough water to complete its life cycle including flower pots, tin cans, plastic buckets, cemetery urns and discarded tyres. Control is difficult because a proportion of mosquitoes still deposits their eggs in natural containers like tree holes which are impossible to eliminate. However the reduction of container breeding sites has shown to be an effective way for people in the community to manage its control near where they live.²²

The discovery of *Aedes Aldopictus* in Malta is of public health importance because it is a competent vector which can result in spread of diseases like Dengue and Chikungunya. Since it is now established locally, the risk of the mosquito becoming infected and starts transmitting disease locally increases. Outbreaks of Chikungunya occurred in Italy in Taranto in 2007²³ in La Reunion in France in 2010²⁴ while cases of Dengue have occurred in Croatia and France in 2010. An outbreak of Dengue occurred in Madeira, Portugal between October and December of 2012 following the discovery of two cases of autochthonous Dengue virus infections with over 1,357 cases of Dengue fever-the first sustained transmission of disease since the last outbreak in Greece in 1927.²⁵

Outbreaks of mosquito borne disease have a considerable economic impact. A cost illness analysis performed on the Chikungunya epidemic in La Reunion island

(2005-2006) where 204,000 cases were infected, estimated the total cost of medical expenses at 42.0 million Euro, of which 60% were direct medical costs and 40% to disease related loss of productivity.²⁶

The most effective means of vector control is environmental management with the aim to modify or manipulate environmental factors with the view to prevent and reduce vector propagation and human-vector-pathogen contact. The methods involved will include improving the water supply and storage, solid waste management and modification of man-made larval habitats. Chemical control using insecticides and also biological control using biocides or larvivorous fish are used to destroy larvae.²⁷

Control measures would need to be applied throughout the whole year since the mosquito continues to breed locally throughout the whole year but can be most effective during the winter period during larvae development. Adult biting activity in winter is very low so the potential transmission of Arboviruses will take place during the period of May and November when adult mosquitoes are present in large numbers.

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