REVIEW ARTICLE

Review on *Culex quinquefasciatus*: Southern House Mosquito

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Received: 22 Oct 2017/Revised: 25 Nov 2017/Accepted: 29 Dec 2017

ABSTRACT- Diseases caused by mosquitoes have been a threat all around the globe since ages and humans have been coping with the disease spread in various possible ways. Mosquitoes are ectoparasites, which are vectors to numerous diseases caused in humans as well as animals, and birds. Through the diseases they carry, it may lead to severe illness and even death. *Culex quinquefasciatus* is one of the mosquito species, which is a potential vector of several arboviruses like West Nile virus (WNV), Rift Valley fever virus, avian pox and protozoa like *Plasmodium relictum*, which causes bird malaria. This mosquito exists throughout the tropics and the lower latitudes of temperate regions. Also, it can transmit several other arboviruses in the laboratory conditions. The present study is an attempt to review the bioecology, medical importance, and impact of phytoextracts on the life of *C. quinquefasciatus*. It acts as an important bridge since it bridges between different reservoir/amplifier hosts to humans because of its encounter with different vertebrates. It also forms an ecological bridge between the urban, periurban and rural areas, which leads to its presence and adaptability in diverse ecological conditions. Emerging as a smart vector because of the features like-adaptive fitness, ecological plasticity, invasive behaviour and high reproductive potential, this mosquito possesses the necessary capability for disease transmission by establishing an effective vector-host transmission cycle for diverse pathogens in variable environments. Thus, in the changing ecological conditions also this mosquito might enhance its epidemiological importance in the near future as a smart vector even for those pathogens, which are presently not even having any public health importance. Hence, studies are being made to find out and prepare plants based environment friendly formulations in order to target this organism because this species may develop resistance to the chemical insecticides due to its high resistivity and adaptability.

Key-words- *Culex quinquefasciatus*, Smart vector, Southern house mosquito, *Plasmodium relictum*

INTRODUCTION

Mosquitoes are vector agents that cause diseases by transmitting the virus and parasite from one person to another [1]. Mosquitoes are the major public health pests and are vectors for many diseases, such as malaria and West Nile Virus [2]. Culex is a genus of mosquito which acts as a vector for many humans, animals as well as birds. The genus is found to be of worldwide occurrence. Mosquito-borne diseases are responsible for significant global morbidity and mortality. *Culex* mosquitoes, especially *C. quinquefasciatus* are the chief vectors of *Wuchereria bancrofti* that cause a disease known as bancroftian filariasis. This disease is common in many regions of the world including the Middle East and Eastern Mediterranean countries [3]. *C. quinquefasciatus* may also cause protozoan, viral, parasitic and helminthic diseases.

Access this article online	
Quick Response Code	Website: www.ijlssr.com
	DOI: 10.21276/ijlssr.2018.4.1.9

The larvae are typically found in the eutrophic water present in artificial containers or man-made impoundments containing any kind of human or animal sewage. In past times, it was uniquely adapted to the environs of historical sailing ships outfitted for long voyages leading to their spread to even distant places. As such this mosquito may contribute to economic loss in small island nations that are dependent on tourism. Since it is the main vector of the disabling disease lymphatic filariasis (LF), it has the ability to cause great health, social and economic harm. Apart from being used as a model organism for the laboratory study of chemical resistance, *C. quinquefasciatus* has no such economic or social value.

Origin and Distribution of *Culex quinquefasciatus*: Although previous studies [4-5] stated that *C. quinquefasciatus* was native to the low land regions of West Africa from where the species has been spread to tropical and warm temperate regions by human activity, recent studies indicated that *C. quinquefasciatus* originated in south-east Asia and then established in the new world through slave ships and colonized Africa [6]. The mosquito is found in tropical and sub tropical regions of the world. These habitats may be natural and man-

made, temporary or permanent. This mosquito species have been subsequently introduced to New Zealand, Australia, and other geographical regions by the anthropogenic activity. In India, investigations to find out the distribution and diversity of mosquito larvae were also done. During the study period, the mosquitoes [7] were found in water storage tanks, plastic vessels, metal vessels, ceramic vessels, barrels, tucker box, tires, coconut shell; temporary pools were found to have *Culex* and *Aedes* species. Forming an ecological bridge this species is present in varied ecological niches. Mosquito-borne zoonotic viral disease which was a rural disease may spill over to urban areas in the changing ecological conditions; as such this mosquito could play an important role not only as a bridge vector between man and pigs/birds (reservoir host) but also bridging the rural-urban eco-epidemiological zones.

Table 1: Habitat List of the *C. quinquefasciatus*

S. No	Category	Habitat
1.	Freshwater	Irrigation areas Ponds Rivers and water streams
2.	Terrestrial or managed areas	Buildings, Metals and Containers Cultivated or agricultural land and livestock areas Industrial systems Railway tracks, puddles and roadsides Urban / peri-urban areas
3.	Terrestrial natural or semi-natural	Natural forests, Depression on trees Rocky areas Wetlands

Morphology of *C. quinquefasciatus*- Adult *C. quinquefasciatus* vary from 3.96 to 4.25 mm in length [8]. It is medium sized mosquito having brown coloration. The body consists of the proboscis, thorax, wings, and tarsi, which is darker than the rest of the body. The head is light brown with the lightest portion of the center. The antennae and proboscis are usually about the same length, but in some cases, the antennae are slightly shorter than the proboscis. The scales of the thorax are narrow and curved. The abdomen has pale, narrow, rounded bands on the basal side of the tergite. Common to the Culex genus, the eggs of C. *quinquefasciatus* are laid in the oval rafts loosely cemented together with 100 or more eggs in a raft which will normally hatch 24 to 30 hours after being oviposited [9].

Similar to other mosquito species, its pupae are comma-shaped and consist of fused head and thorax (cephalothorax and an abdomen). The abdomen has eight segments. The first four segments are the darkest and the color lightens towards the posterior. The paddle, at the apex of the abdomen, is translucent and robust with two small setae on the posterior end [10].

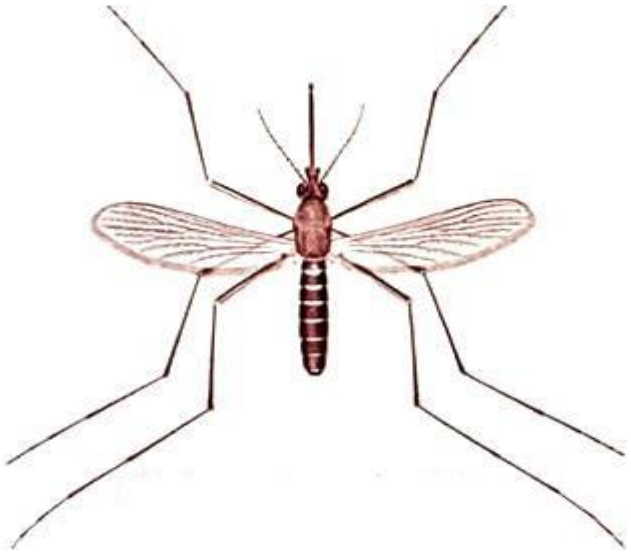

Fig. 1: Structure of adult *C. quinquefasciatus* mosquito
Source: https://www.cdc.gov/parasites/lymphaticfilariasis/gen_info/vectors.html

Medical Importance of the *C. quinquefasciatus*- *C. quinquefasciatus* is a vector of many pathogens of humans, birds and both domestic and wild animals. *It* is the primary vector of St. Louis encephalitis virus (SLEv) and also transmits West Nile virus (WNv). As such the viruses transmitted by this species include WNv, SLEv and Western equine encephalitis virus (WEEv). The virus increases its population in birds and later infects mosquitoes feeding on these birds during the bird nesting season in the spring. The mosquito may then transmit the virus to humans. St. Louis encephalitis is age-dependent, affecting older humans more than the younger individuals. Symptoms of this disease are flu-like and can range from fever, headaches to stiffness and confusion. Humans do not develop high levels of the virus in the blood and therefore are considered dead-end hosts unable to infect mosquitoes [11]. There are many other diseases and various symptoms caused due to the transmission of viruses on to humans because of this vector. From the public health standpoint the importance of Southern House Mosquito, *C. quinquefasciatus* as a mosquito vector relies on the fact that it is the principal vector of bancroftian filariasis and a potential vector of *Dirofilaria immitis*. It is also a competent vector of several arboviruses like West Nile virus (WNV) in north eastern United States and Asia [12,13] St. Louis encephalitis virus (SLEV) in eastern and south-central North America, Rift Valley fever virus, and several protozoa like *Plasmodium relictum* that causes bird malaria [14].

Effect of Insecticides and Plant extracts on *C. quinquefasciatus*- *C. quinquefasciatus* control was mainly conducted through the use of neurotoxic

insecticides belonging to the Organochlorines (OC), the Organophosphates (OP) and the Pyrethroids (PYR) families in the western Indian Ocean islands [15]. The enzymatic detoxification (i.e. metabolic resistance) and target site modification are the two major insecticide resistance mechanisms found in mosquitoes. Repeated use of synthetic insecticides for mosquito control has disrupted natural biological control systems and led to resurgences in mosquito populations [16]. The mosquito larval control through the use of a larvicidal agent is a major component in the controlling the vector-borne diseases. Plants as potential larvicides are considered as a viable and preferred alternative in the control of mosquito species at the community level [17]. Plants are considered as a rich source of bioactive chemicals and they may be an alternative source of mosquito control agents. Studies have been conducted to observe the effect of the plant extracts on the larva of mosquito. Findings of such investigation have shown that *Eucalyptus tereticornis* has good larvicidal activity against *C. quinquefasciatus* larvae. In another study, Apigenin was isolated from the leaves of *Jatropha gossypifolia*, which was highly toxic to *C. quinquefasciatus* larvae [18]. This extract significantly suppressed the population build up of the mosquito by morphogenetic effect on an insect. The extract caused significant behavioral changes in the larvae which appear after four to five hours after exposure. Larvae showed restlessness, loss of equilibrium, lethargy and finally dead.

Table 2: List of Parasites isolated from *C. quinquefasciatus* in different (natural and artificial) conditions

S. No	Parasites isolated from *C. quinquefasciatus*	References
1	Rift Valley fever virus (Bunyaviridae)	Meegan [19]
2	*Plasmodium relictum*	Atkinson *et al.* [14]
3	*Dirofilaria immitis*	Lai [20]
4	*Wuchereria bancrofti*	Bram [21]
5	Japanese encephalitis virus (JEV)	Yan-Jang *et al.* [22]
6	West Nile virus (Flaviviridae)	Goddard *et al.* [23]

CONCLUSIONS

With changing environmental conditions like global warming, globalization, increasing level of all forms of pollution, are likely to change and modify the ecology of vector mosquitoes, such as *C. quinquefasciatus*. This might have a wide range consequence on the epidemiology of the vector-borne diseases. Different studies have described the effect of various phytochemical compounds on this vector species and varying level of effectiveness depending on the concentration used. Also, the effect varies according to the *plant* parts used from which these compounds are extracted and the developmental stages of mosquito against the specified *extract*. The plants extract like- *J. gossypifolia*, *E. tereticornics*, etc are the alternatives to synthetic chemicals used since they are safer, inexpensive and as such, there is a reduced dependence on imported products. They are also easily readily available and biodegradable. Therefore plant extracts are the potential for eco-friendly alternative to all the chemicals to control the vectors spreading diseases. Also, it may be concluded that there is wide scope for the discovery of more possible and highly effective plant products against *C. quinquefasciatus*. The methods to stop the spread of the diseases are through cost-effective, environmental friendly phytoproducts.

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How to cite this article:

Negi C, Verma P. Review on *Culex quinquefasciatus*: Southern House Mosquito. *Int. J. Life Sci. Scienti. Res.*, 2018; 4(1):1563-1566. DOI:10.21276/ijlssr.2018.4.1.9

Source of Financial Support: Nil, **Conflict of interest:** Nil