*J Vector Borne Dis* 45, March 2008, pp. 70–72

# Sunlight exposure enhances larval mortality rate in *Culex quinquefasciatus* Say

V. Swain[a], S.S. Mohanty[b] & K. Raghavendra[b]

[a]*Department of Zoology, University of Delhi, Delhi;* [b]*National Institute of Malaria Research (ICMR), Delhi, India*

**Key words** *Culex quinquefasciatus* – mortality – sunlight

The sunlight is responsible for the development and continued existence of life on earth. The deleterious effects of sunlight on biological systems are entirely due to radiation. It is widely believed that light has the greatest effect of all the environmental factors[1]. While light does play an important role, very few studies have been conducted to evaluate the interaction of light with other factors[2]. Natural sunlight includes wavelengths as low as 300 nm, but does not include wavelengths of 250 to 260 nm (as ozone layer blocks these wavelengths from reaching the atmosphere). Radiation in incident sunlight has shown effect on the bacterial spores and crystals[1]. The effect of sunlight has been well reviewed in case of insecticide degradation or photo degradation of *Bacillus* species with reference to control of aquatic mosquito larvae. Effect of varying temperature during the daytime due to incident sunlight was assessed for survival in malathion resistant and susceptible larvae of *Culex quinquefasciatus* Say (Diptera: Culicidae).

Laboratory reared (27 ± 2°C) fourth instar larvae of *Cx. quinquefasciatus,* both malathion resistant (RR) and susceptible (SS) strains were exposed to direct sunlight. Three replicates (n = 3) each having 25 larvae were placed in 500 ml beakers half-filled with distilled water and exposed to direct sunlight. Temperature and mortality were recorded at hourly intervals for a period of six hours. After larval mortality, the data were subjected to one way ANOVA followed by *t*-test.

Analysis of variance (ANOVA) on data pertaining to the effect of sunlight on *Cx. quinquefasciatus* indicated that there was a significant influence on the larval survival rates of both the strains (F = 29.57 and 44.57 for resistant and susceptible strains respectively). The experiment started at 1100 hrs when the temperature was 30°C and within an hour it went up by 5°C. No mortality was observed at 35°C in both the strains. When the temperature went up to a peak of 41°C at 1300 hrs, the mortality was 24% in RR and 22% in SS strains and further increased up to 52% and 88% respectively up to 1700 hrs. Both the strains had almost similar mortality rates initially (p >0.05; Table 1). The effect of sunlight on the larval mortality of both the strains of *Cx. quinquefasciatus* was not

**Table 1. Effect of sunlight on IV instar larvae of *Culex quinquefasciatus***

| Exposure time (hrs) | Temperature (°C) | % Larval mortality | |
|---|---|---|---|
| | | RR | SS |
| 1100 | 30 | $0 \pm 0^a$ | $0 \pm 0^a$ |
| 1200 | 35 | $0 \pm 0^a$ | $0 \pm 0^a$ |
| 1300 | 41 | $24.0 \pm 6.1^b$ | $22.6 \pm 7.0^b$ |
| 1400 | 39 | $25.3 \pm 4.8^b$ | $24.0 \pm 6.1^b$ |
| 1500 | 39 | $38.0 \pm 4.6^c$ | $28.0 \pm 8.0^c$ |
| 1600 | 38 | $41.3 \pm 1.3^c$ | $85.3 \pm 4.8^d$ |
| 1700 | 38 | $52.0 \pm 2.3^e$ | $88.0 \pm 6.1^f$ |

Means ± SE followed by the same superscript letter in a row are not significantly different at p <0.001 level (ANOVA followed by *t*-test). RR– Resistant strain; SS– Susceptible strain.

statistically different up to 1500 hrs—after 4 h of sunlight exposure. After a period of six hours sunlight exposure, the mortality of susceptible strain almost doubled that of the resistant ones. Sunlight induced larval mortality was more in SS (88%) starin than in the RR (52%) strain indicating a significant difference ($p < 0.001$; Table 1; Fig. 1).

The effectiveness of light-induced killing of mosquito larvae in *Aedes aegypti*, *Anopheles stephensi* and *Cx. quinquefasciatus* has been reported[3].While considering sunlight exposure, two intrinsic factors come into play, UV radiation and subsequent warming up. The observed mortalities in the mosquitoes even during the decreasing temperature indicate the adaptive effects of the radiation induced physiological mechanisms. In the present experiment the effect was assessed by observing the percent mortalities in the strains. When genetically altered or resistant strain population is subjected to the above factors variation occurs in the mortalities as compared to the susceptible strain. Moreover, available literature reveals that temperature and insecticide selection pressure drastically alter the genetic structure of the population in an area[4]. Present study revealed that resistant strain has shown relatively better thermal adaptation than the susceptible one as indicated by increased survival rate.

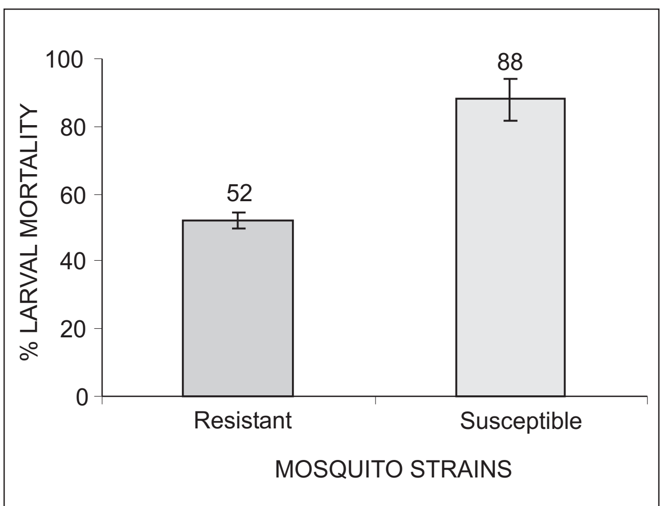


*Fig. 1:* Mortality after 6 h sunlight exposure. Mean values of both the strains were significantly different ($p < 0.001$)

In natural habitats the aquatic larvae are usually surrounded by a canopy of vegetation and emergent plants. Dense vegetation usually supports mosquito proliferation[5]. Land cover may also affect larval survivorship and adult productivity[6] as penetration of light and temperature are minimised under such natural conditions. The depth of the water is another factor that affects the penetration of sunlight. Life exists within a range of temperature with certain physiological adaptations such as poikilothermy, selection of preferred temperature in the natural water column, variations in water habitats, regulation of water loss and other metabolic processes[7].

## Acknowledgement

The first author acknowledges the University Grants Commission (UGC), New Delhi, India for the grant of research award and financial support.

## References

1. Wendy DG. Environmental persistence of *Bacillus thuringiensis* and other bacterial pathogens. In: Baur ME, Fuja JR, editors. *Factors affecting the survival of Entomopathogens. Southern Cooperative Series Bulletin*. San Diego, California: PACE Consulting 1998.
2. Leong KL, Cano RJ, Kubinski AM. Factors affecting *Bacillus thuringiensis* total field persistence. *Environ Entomol* 1980; *9:* 593–9.
3. Dondji B, Duchan S, Diabate A, Herve JP, Corbel V, Hougard JM, Santus R, Schrevel J. Assessment of laboratory and field assays of sunlight induced killing of mosquito larvae by photo sensitizers. *J Med Entomol* 2005; *42*(4): 652–6.
4. Yadav P, Barde PV, Gokhale MD, Vipat V, Mishra AC, Pal JK, *et al*. Effect of temperature and insecticide stresses on *Aedes aegypti* larvae and their influence on the susceptibility of mosquitoes to dengue-2 virus. *Southeast Asian J Trop Med Public Health* 2005; *36:* 259–64.
5. Russel RC. Constructed wetlands and mosquitoes: health hazards and management options – an Australian perspec-

tive. *Ecol Eng* 1999; *12*(1-2): 107–24.

6. Munga S, Minakawa N, Zhou G, Mushinzimana E, Barrack O-O J, Githeko AK, Yan G. Association between land cover and habitat productivity of malaria vectors in western Kenyan highlands. *Am J Trop Med Hyg* 2006; *74:* 69–75.

7. Prosser CL. *Comparative animal physiology*. Philadelphia: Saunders Co., 1952; p. 374.

*Corresponding author:* Dr Vijayalakshmi Swain, Department of Zoology, University of Delhi, Delhi–110 007, India.
E-mail: vijayalakshmi.swain@rediffmail.com

*Received:* 3 January 2008 *Accepted:* 31 January 2008