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Raju Kushwah
Entomology Research Lab
School of Studies in Zoology
Jiwaji University, Gwalior,
Madhya Pradesh, India

OP Agrawal
Entomology Research Lab
School of Studies in Zoology
Jiwaji University, Gwalior,
Madhya Pradesh, India

Corresponding Author:
OP Agrawal
Entomology Research Lab
School of Studies in Zoology
Jiwaji University, Gwalior,
Madhya Pradesh, India

A comparative study on different types of eco-friendly mosquito traps for surveillance and management

Raju Kushwah and OP Agrawal

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Abstract
Mosquitoes are the most important among all the arthropod vectors that cause human disease in tropical conditions. In order to reduce the mosquito nuisance and the risk of diseases caused by them, it is essential to reduce the mosquito population. Mosquito traps are very useful devices for the surveillance and management of mosquito vectors. It works on the attraction behavior of insects. An ultraviolet or fluorescent light is fitted into the trap for the attraction of mosquitoes. The attracted mosquitoes are killed by a vacuum created by a small exhaust fan. The system does not involve any hazardous chemicals and is perfectly eco-friendly; however, its use has been neglected in India. In the present study, four different types of mosquito traps were procured from online marketing. All the mosquito traps were placed in the animal house of school of studies in zoology, Jiwaji University, Gwalior. Out of total insects trapped, the percentage of mosquitoes was 68 % in the terminator-I, 84% in the terminator-II, 70% in mozziquite, and 38% in the UV LED light-based trap within 6 months. According to device specification and insect trapping, the terminator-II (All Iinn mosquito trap) was found to be comparatively more effective for surveillance and control of mosquitoes.

Keywords: Mosquito trap, mosquito control and mosquito surveillance

Introduction
Mosquitoes are the most important arthropod vectors of human diseases like dengue, Zika, Yellow fever, Chikungunya, Malaria, Filariasis, and Japanese Encephalitis in the tropics (Ong *et al*. 2022). They are notoriously responsible for causing much greater miscry to humanity than all other insects. In order to reduce the mosquito nuisance and the risk of disease caused by them, it is essential to reduce mosquito populations. A variety of measures are adopted for this purpose, but the problem still persists. Chemical insecticides and mosquito-repelling devices could not solve the problems adequately and an integrated approach is required. Mosquito traps are a much better option for controlling them and estimating species abundance and composition. A large number of traps have been developed by Sudia and Chamberlain (1962) [20], Odetoyinbo (1969) [9], Service (1970) [13], Davis *et al*. (1995) [10], Mathenge *et al*. (2002) [7], Hoel *et al*. (2007) [3], Brown *et al*. (2008) [8], Kaufman *et al*. (2008) [15], Ritchie *et al*. (2008) [1] and Kweka and Mahande (2009) [6]. Eco-friendly mosquito traps have been better for reducing the mosquito population (Ganai *et al*., 2013) [18]. A 2-liter plastic bottle trap is much better for killing both the adult mosquitoes and their offspring developed from the laid eggs (Bhat *et al*. 2013) [16]. But a significant success in mosquito control has yet to be achieved. In the present study, four different types (Terminator-I, Terminator-II, mozziquite and UV LED light-based) of commercially available mosquito traps have been used. The device involves a number of attractive cues, UV light, Heat, Moisture (humidity) and carbon dioxide for the creation of an atmosphere mimicking human skin, for female mosquitoes. The system does not involve any hazardous chemicals and is perfectly eco-friendly. Such studies have been conducted to demonstrate the effectiveness of mosquito traps yet to be achieved; therefore, the present study has been taken up with the objectives of installing mosquito traps in the animal house during monsoon and post monsoon sessions for 6 months and 24-hour durations so as to observe the abundance of insect species.

Materials and Methods

All mosquito traps model Terminator-I, Terminator-II, Leowin model Mozziquite and UV LED light-based traps were procured from market. The device works on the principle of attraction behavior of mosquitoes, particularly the females, with the creation of an atmosphere imitating human skin. All four types of traps are fitted with small fluorescent (UV) tube and its inner walls are coated with titanium dioxide (TiO2) a natural oxide of the earth mineral that is non-toxic and is widely used in paints and to combat environmental pollution worldwide.

A photo-catalytic reaction takes place when UV rays radiate TiO2, resulting in the generation of heat, moisture, and CO2, in the presence of organic carbon (bacteria). Thus, hungry female mosquitoes are attracted to the trap through capture windows on the upper part of the system. The attracted mosquitoes are sucked into a cage, at the lower part, by the vacuum created by a small exhaust fan. The trapped mosquitoes cannot fly upwards because of the strong air flow of the ventilator. In a few hours, they die out due to dehydration under the influence of air blown onto them. The system does not involve any hazardous chemicals and is perfectly eco-friendly.

Mosquito traps were installed for 6 months at the animal house of school of studies in zoology, Jiwaji University. Most of them were installed for nocturnal surveys for a period of 24 hours. Trapped and killed insects were collected in Petri dishes. The Petri dishes were placed in an oven at 60˚C for 12 hours to remove the moisture of the insects and then they were stored in air-tight plastic containers, for further study. The trapped insects were stored according to their orders. Identification of mosquitoes up to the genus level was carried out with the help of (the taxonomic key by Christophers, Nagpal, and Sharma). The data obtained were tabulated and subjected to statistical analysis.

Results

The findings of the present study on the basis of device specification, Terminator-I (All Iinn mosquito trap) is more effective because of its low weight, small size, low power consumption, and noise free.

The observations of the present study have been depicted in figures I-III. The number of mosquitoes and other insects trapped in different mosquito traps was observed and recorded. The number of mosquitoes caught per day at the animal house (a good place for breeding and hiding mosquitoes) was 02-316.

The observations shown in tables (1-7) revealed that the total number of insects collected in mozziquite was 207, and the percentage of mosquitoes was 50%. Whereas in Terminator-I, the total number of insects collected in 6 months was 693 out of which the percentage of mosquitoes was 30%. Similarly, the number of insects caught in Terminator-II was 2814, out of which the number of mosquitoes was 37%. Therefore, based on findings from the comparative study of insects trapped in the above four traps. It can be concluded that the Terminator-II is more useful and effective than other traps for the surveillance and management of mosquitoes.

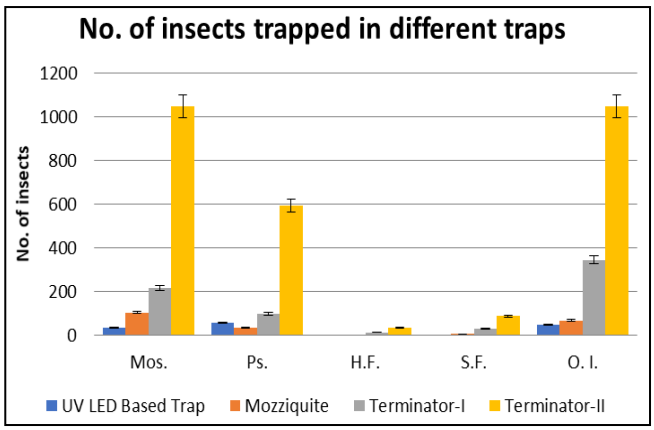
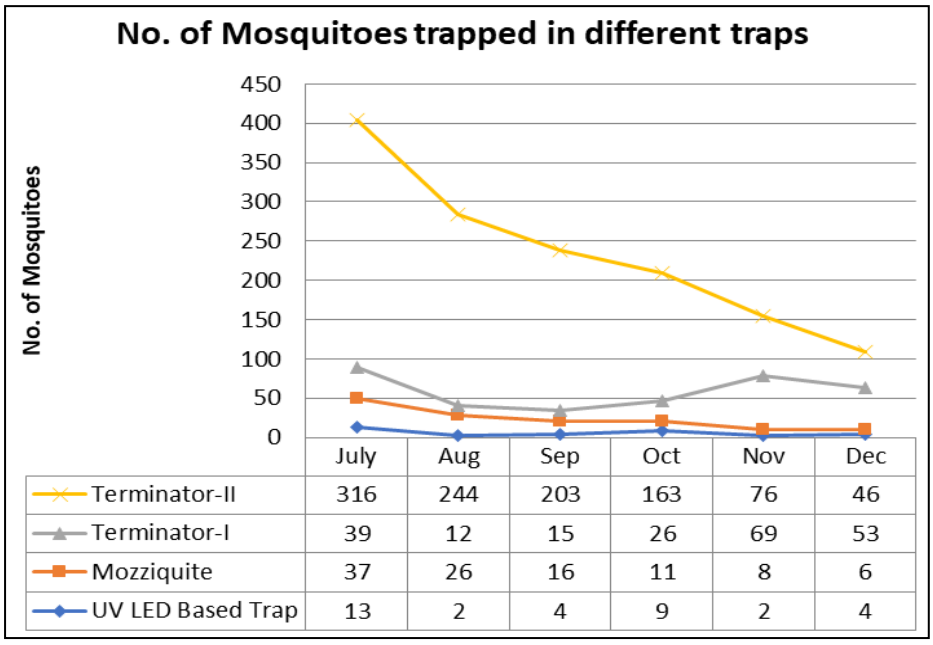


Fig 1: Showing the no. of insects trapped in different light-based mosquito traps.



	July	Aug	Sep	Oct	Nov	Dec
Terminator-II	316	244	203	163	76	46
Terminator-I	39	12	15	26	69	53
Mozziquite	37	26	16	11	8	6
UV LED Based Trap	13	2	4	9	2	4

Fig 2: Showing the no. of mosquitoes trapped in different types of light-based mosquito trap.

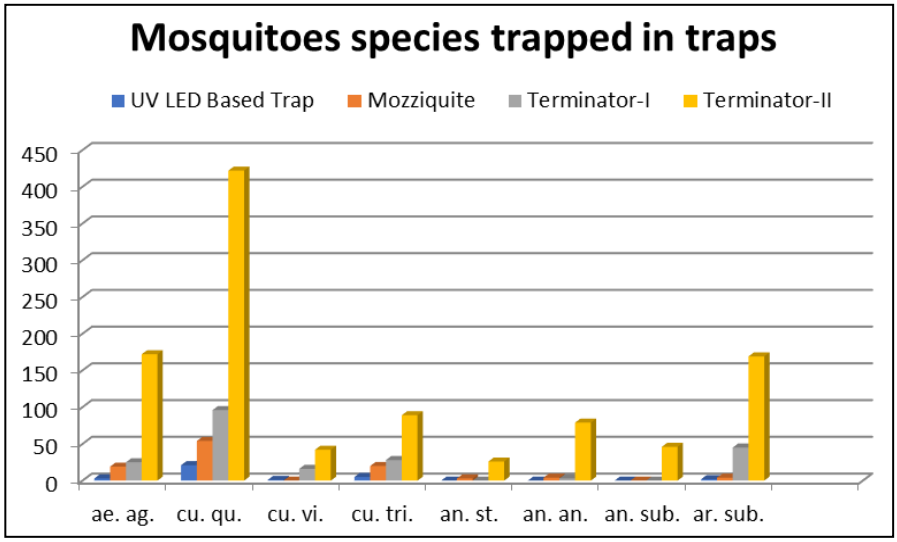


Fig 3: Showing the trapped mosquito's species in different light-based mosquito trap

Table 1: Comparative study on the basis of device specification

	Height	Length	Weight	Type of Lamp	Size of Fan	TiO_2	Power Consumption	Input Voltage
Terminator-I	8"	4.5"	425 g	UV Flurocent Tubular lamp 1.5 W	4" Low noice	Coated	6W 1.5 Unit/month	220V AC 50 Hz
Terminator-II	12"	8"	1125 g	UV Flurocent Tubular lamp 4 W	6" Low noise	Coated	26W 6.5 Unit/month	220V AC 50 Hz
Mozziquite	8.5"	8.5"	976 g	UV Flurocent Tubular lamp 4 W	6" with noise	Non Coated	26W 6.5 Unit/month	220V AC 50 Hz
UV-LED light based trap	8"	4.5"	425 g	UV LED light 1.5 W	4" Low noice	Coated	6W 1.5 Unit/month	220V AC 50 Hz

Table 2: The number of mosquitoes and other insects trapped in terminator-I were observed

Month	Mosquito	Psycodide	Housefly	Sandfly	Other Insects
July	39	15	2	2	94
August	12	2	8	0	21
September	15	4	0	2	30
October	26	13	1	0	21
November	69	50	0	14	163
December	53	13	1	11	15
Total	214	97	12	29	344

Table 3: The number of mosquitoes and other insects trapped in terminator-II were observed

Month	Mosquito	Psycodide	Housefly	Sandfly	Other Insects
July	316	38	2	36	222
August	244	128	12	13	117
September	203	255	9	27	428
October	163	142	7	12	296
November	76	24	3	0	45
December	46	8	0	0	42
Total	1048	595	33	88	1050

Table 4: The number of mosquitoes and other insects trapped in mozziquite were observed

Month	Mosquito	Psycodide	Housefly	Sandfly	Other Insects
July	37	4	0	1	26
August	26	5	0	0	3
September	16	8	0	1	12
October	11	9	0	0	9
November	8	7	0	0	14
December	6	1	0	0	3
Total	104	34	0	2	67

Table 5: The number of mosquitoes and other insects trapped in UV-LED light based trap were observed

Month	Mosquito	Psycodide	Housefly	Sandfly	Other Insects
July	13	4	0	0	21
August	2	2	0	0	6
September	4	0	0	0	5
October	9	35	0	0	10
November	2	13	0	0	2
December	4	3	0	0	2
Total	34	57	0	0	46

Table 6: Showing the number of mosquitoes and other insects trapped in different types of mosquito trapping device were observed (Mean±S.E.)

Types of trap	Mosquitoes (Mean±SE)	Psycodid (Mean±SE)	House fly (Mean±SE)	Sand fly (Mean±SE)	Other than Diptera (Mean±SE)
Terminator-I	35.6±9.1	16.1 ±7.1	2.0 ±1.2	4.8 ±2.4	57.3 ±24.2
Terminator-II	174.6 ±41.6	99.1 ±38.5	5.5 ±1.8	14.6 ±5.9	191.6 ±62.4
Mozziquite	17.3 ±4.8	5.6 ±1.2	0 ±0	0.3 ±0.2	11.1 ±3.4
UV-LED	5.6 ±1.8	9.5 ±5.4	0 ±0	0 ±0	7.6 ±2.9

Table 7 A: Numbers of trapped mosquito species in UV light based trap (Terminator-I).

	Aedes				*Culex*						*Anopheles*						Armigera	
	ae. al.		*ae. ag.*		*cu. qu.*		*cu. vi.*		*cu. tri.*		*an. st.*		*an. an.*		*an. sub.*		*ar. sub.*	
Months	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
July	0	0	2	4	21	12	0	0	0	0	0	0	0	0	0	0	0	0
Aug	0	0	1	2	4	1	0	1	0	2	0	0	0	1	0	0	0	0
Sep	1	0	0	2	2	3	0	0	1	1	0	0	1	1	0	0	0	1
Oct	1	0	2	3	9	8	0	0	0	1	0	0	0	0	0	0	2	1
Nov	0	1	1	6	5	9	2	3	0	4	0	0	0	0	0	0	11	27
Dec	0	0	1	1	15	7	7	3	13	6	0	0	0	0	0	0	2	1
Total	2	1	7	18	56	40	9	7	14	14	0	0	1	2	0	0	15	30

Table 7 B: No. of trapped mosquito species in Fluorescent light based trap (Terminator-II).

	Aedes				*Culex*						*Anopheles*						Armigera	
	ae. al.		*ae. ag.*		*cu. qu.*		*cu. vi.*		*cu. tri.*		*an. st.*		*an. an.*		*an. sub.*		*ar. sub.*	
Months	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
July	2	3	17	12	122	134	8	17	0	0	0	0	0	0	0	0	0	1
Aug	3	2	19	26	70	30	1	3	5	9	8	3	16	15	9	6	10	9
Sep	0	4	10	25	11	18	0	1	7	21	3	5	6	20	8	8	29	47
Oct	0	3	7	17	3	9	0	1	5	14	3	4	5	17	8	7	24	37
Nov	1	2	18	10	11	1	2	7	8	8	0	0	0	0	0	0	0	8
Dec	0	3	2	10	9	4	1	1	3	9	0	0	0	0	0	0	2	2
Total	6	17	72	100	226	196	12	30	28	61	14	12	27	52	25	21	65	104

Table 7 C: No. of trapped mosquito species in Mozziquite.

	Aedes				*Culex*						*Anopheles*						Armigera	
	ae. al.		*ae. ag.*		*cu. qu.*		*cu. vi.*		*cu. tri.*		*an. st.*		*an. an.*		*an. sub.*		*ar. sub.*	
Months	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
July	0	0	1	2	18	7	0	0	2	6	0	1	0	0	0	0	0	0
Aug	0	1	0	9	5	8	0	0	1	2	0	0	0	0	0	0	0	0
Sep	1	1	2	1	3	2	0	0	1	1	0	0	2	1	0	0	0	1
Oct	0	0	1	2	3	1	0	0	3	1	0	0	0	1	0	0	0	2
Nov	0	0	0	1	2	2	0	0	0	1	2	0	0	0	0	0	0	0
Dec	0	0	0	0	1	2	0	0	1	1	0	0	0	0	0	0	1	0
Total	1	2	4	15	32	22	0	0	8	12	2	1	2	2	0	0	1	3

Table 7 D: No. of trapped mosquito species in UV-LED light based trap.

	Aedes				*Culex*						*Anopheles*						Armigera	
	ae. al.		*ae. ag.*		*cu. qu.*		*cu. vi.*		*cu. tri.*		*an. st.*		*an. an.*		*an. sub.*		*ar. sub.*	
Months	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
July	0	0	0	0	7	5	1	0	0	0	0	0	0	0	0	0	0	0
Aug	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sep	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	2
Oct	0	0	0	0	4	2	0	0	1	2	0	0	0	0	0	0	0	0
Nov	0	0	0	0	1	1	0	0	0	2	0	0	0	0	0	0	0	0
Dec	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	1	2	12	9	1	0	1	4	0	0	0	0	0	0	0	2

Abbriviations: *ae.al.=aedes albopictus; ae. ag.= aedes aegypti; cu. qu.=culex quenqufaciculatus; cu. vi.=culex vishnui; cu. tri.=culex tritenerhyncus; an. st.=anopheles stephensi; an. an.=anopheles annularis; an. sub.=anopheles subpictus; ar. sub.=armigera subalbus*; *M=Male; F=Female.*

Discussion

The trap is a device that captures the desired animals (mosquitoes). It allows the mosquitoes to get in, but it does not permit them to go out. Traps have become a very effective and useful device for sampling (collection of samples) of insects, including mosquitoes. Different models and types of devices have been described for the trapping of food-seeking mosquitoes; some of them are commercially available. Traps are commonly used in vector and disease surveillance programs, but some models have also been shown to be effective for mosquito control (Quarles, 2004; Ganai *et al*., 2013) [21, 18]. Daily observations of all four types of mosquito traps installed show that the Titanium dioxide coating in Terminator is more effective for capturing insects than mozziquit and UV LED light-based traps because the photo catalytic reaction of Titanium dioxide produces CO2, heat, and moisture, as well as UV light, which attracts mosquitoes and other insects.

The findings of the present study are more or less similar to those of studies conducted by Moree *et al*. (2001), who reported that UV light traps caught more mosquitoes than the traps with incandescent bulbs. Also, Hoel *et al*. (2009) [2] reported the maximum collection of Aedes albopictus using commercial mosquito traps. The octenol trap is known to be an attractant for most Aedes and some Culex mosquitoes (Kline *et al*., 1991a,b; Kline, 1994; Kline & Mannm, 1998) [11-12, 4-5]. In addition, Krockel *et al*. (2006), Maciel-de-Freitas *et al*. (2006) [17] and Williams *et al*. (2006) [1] compared the efficacy of the BG-SentinelTM mosquito trap (BGS) to other traps or active collection methods and reported the trap as an effective tool for capturing adult Aedes aegypti in the outdoor environment. In the present study, it was observed that the maximum numbers of mosquitoes (1048) were collected in Terminator-II. The results obtained are in accordance with those of some earlier workers who reported that maximum number of mosquitoes can be trapped by using UV light-based mosquito traps. The other insects which are trapped in the trap are attracted due to the light in the trap. Mostly, there is more than 50% of mosquitoes are caught in Terminator-I.

Conclusion

On the basis of the results of the present study, it may be concluded that the Terminator-II trap used in the study acts as a good eco-friendly device for the control and sampling of mosquitoes compared to other mosquito traps and the use of these traps does not cause any environmental pollution. In further studies, more mosquito attractive cues are being tested.

References

1. Williams CR, Long SA, Russel RC, Ritchie SA. Field efficacy of the BG-Sentinel compared with CDC backpack aspirators and CO_2-baited EVS traps for collection of adult *Aedes aegypti* in Cairns, Queensland, Australia. J. Am. Mosq. Contr. Assoc. 2006;22:296-300.
2. Hoel DF, Kline DL, Allan SA. Evolution of six mosquito traps for collection of *Aedes albopictus* and associated mosquito species in a suburban setting in North Central Florida. J Am. Mosq. Contr. Assoc. 2009;25(1):47-57.
3. Hoel DF, Kline DL, Allan SA, Grant A. Evaluation of carbon dioxide, 1-octen-3ol, and lactic acid as baits in mosquito magnet pro traps for *Aedes albopictus* in north central Florida. J. Am. Mosq. Contr. Assoc. 2007;23:11-17.
4. Kline DL, Mann MO. Evaluation of butanone, carbon dioxide and 1-octen-3-ol as attractants for mosquitoes associated with North Central Florida bay and Cypress swamps. J Am. Mosq. Contr. Assoc. 998;14:289-297.
5. Kline DL. Olfactory attractants for mosquito surveillance and control: 1-octen-3-ol. J Am. Mosq. Control Assoc. 1994;10:280-287.
6. Kweka EJ, Mahande AM. Comparative evaluation of four mosquitoes sampling methods in rice irrigation schemes of lower Moshi, Northern Tanzania. Journal of Malar. 2009;8:149.
7. Mathenge EM, Killeen GF, Oulo DO, Irungu LW, Ndegwa PN, Knols BS. Development of an exposure-free bed net trap for sampling afro tropical malaria vectors. Med. Vet. Entomology. 2002;16:67-74.
8. Brown HE, Paladini M, Cook RA, Kline D, Barnard D, Fish D. Effectiveness of mosquito traps in measuring species abundance and composition. Journal of Med. Entomology. 2008;45:517-521.
9. Odetoyinbo JA. Preliminary investigation on the use of a light-trap for sampling malaria vectors in The Gambia. Bull. Wld. Hlth. Org. 1969;40:547-560.
10. Davis JR, Hall T, Chee EM, Majala A, Minjas J, Shiff CJ. Comparision of sampling anopheline mosquitoes by light-trap and human-bait collections indoors at Bagamoyo, Tanzania. Med. Vet. Entomology, 9, 249-255.
11. Kline LD, Dame DA, Meisch MV. Evaluation of 1-octen-3-ol and carbon dioxide as attractants for mosquitoes associated with irrigated rice fields in Arkansas. J. Am. Mosqu. Contr. Assoc. 1991a;7:165-169.
12. Kline LD, Takken W, Wood JR, Cornell JA. Interactive effects of 1-octen-3-ol and carbon dioxide on mosquito (Diptera: Culicidae) surveillance and control. J Med. Entomol. 1991b;28:254-258.
13. Service MW. A battery-operated light-trap for sampling mosquito populations. Bull. Wld. Hlth. Org. 1970;43:635-641.
14. Ong SQ, Pauzi MB, Gan KH. Text Mining in Mosquito-Borne Disease: A Systematic Review. Acta Tropica. 2022;14:106447.
15. Kaufman PE, Butler JF, Nelson C. Evaluation of the mosquito sentinel 360 trap in Florida residential environments. Journal of American Mosquito Control Association. 2008;24:528-533.
16. Bhat RA, Agrawal OP. Simple mosquito ovitrap: an excellent and eco-friendly tool for surveillance and management of dengue and chikungunya vectors. Journal of Basic and Applied Biology. 2013;7:77-84.
17. Maciel-de-Freitas R, Eiras AE, Lourenco-de-Oliveira R. Field evaluation of effectiveness of the BG-Sentinel, a new trap for capturing adult *Aedes aegypti* (Diptera: Culicidae). Mem. Inst. Oswaldo Cruz. 2006;101:321-325.
18. Ganai SA, Kumar R, Basheer M, Agrawal OP. A study on sampling of mosquitos using eco-friendly mosquito trap in around Jiwaji University Campus (India). Munis Entomology & Zoology. 2013;8(2):734-738.
19. Moore SJ, Zunwei D, Hongning Z, Xuezhong W,

Hongbing L, Yujiang X. The efficacy of different mosquito trapping methods in a forest-fringe village, Yunnan Province, Southern China. Southeast Asian Journal of Trop. Med. Publ. Hlth. 2001;32(2):282-289.
20. Sudia WD, Chamberlain RW. Battery operated light trap, an improved model. Mosq. News. 1962;22(2):126-129.
21. Quarles W. Mosquito attractants and Traps. Common Sense Pest Control Quarterly. 2004;19(2):4-13.