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EVALUATION OF OVIPOSITION BEHAVIOUR OF *CULEX QUINQUEFASCIATUS MOSQUITO*AT VISAKHAPATNAM DISTRICT, ANDHRAPRADESH

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ABSTRACT

Mosquito borne diseases are major supporters to the communicable illness burden within the South-East Asia locale. Within the display examination, both juvenile and develop stages of different mosquito species were collected fromdifferent areas of Visakhapatnam district, Andhra Pradesh during 2019. Mosquitoes were distinguished based on the examination of the ordered keys and *Culexquinquefasciatus* mosquitoes were copiously accessible in nearly all chosen ponder destinations. In arrange to discover out oviposition inclination, gravid female *Culexquinquefasciatus* were permitted to oviposit in ovitraps with diverse concentrations of NaCl, totally different colouredovitraps, in water from distinctive sources, in hatchling holding water and completely different measured ovitraps. Comes about of research facility oviposition bioassays appeared that the number of egg flatboats laid by gravid *Culexquinquefasciatus* steadily diminished with increment in NaCl concentration. When gravid mosquitoes were permitted for oviposition totally different coloured ovitrap, black ovitraps was found to be the foremost favored colour by this mosquito species. Water tests collected from diverse sources were utilized within the ovitraps to get it the ovi position preference of this mosquito species. Water collected from paddy field was found to be the foremost favored water among all other water test studied. Finally, it was taken note that *Culexquinquefasciatus* laid greatest number of egg flatboats in ovitraps containing hatchling holding water than refined water. In connection to the holder measure, female grown-up *Culex* mosquito kept clearly more egg pontoons within the biggest ovitrap taken.

KEYWORDS: South-East Asia, Visakhapatnam District, Andhra Pradesh, Ovitrap & Oviposition

1. INTRODUCTION

Vector-borne diseases account for around 20% of all irresistible infections, causing more than 1- million passing every year, among which mosquito vector borne diseases plays a major part (WHO, 2014). In later a long time, vector-borne diseases have risen as a genuine open wellbeing issue in nations of the South-East locale, counting India (Thankachan and Gopinath, 2017). In spite of serious inquire about and gigantic consumption towards the control of mosquito vector borne diseases, no such techniques are compelling till presently. Satisfactory information on mosquito science is the establishment on which ready to trust to control them and along these lines the mosquito vector borne diseases. The foremost imperative practices of mosquito vectors incorporate nourishing and oviposition.

Mosquito species contrast within the sort of sea-going territories they favor for oviposition based on area, physicochemical condition of the water body and the nearness of potential predators (Piyaratnea*et al*., 2005). Blaustein and Kotler (1993) expressed that mosquitoes utilize chemical and natural signals to distinguish the nearness of larval competitors and maintain a strategic distance from ovipositing in such living spaces. Be that as it may, the particular prompts that trigger oviposition conduct in mosquitoes are not clear.

Culexquinquefasciatus is the foremost far reaching mosquito species, found from timberland to semi-desert and having the capacity to alter its regular cycle of regenerative action to the situations, extending from mild mainland climates to sticky tropics. The transcendent species is endemic in all tropical regions dwelling for the most part in houses (Kohn, 1990) and acts as major urban vectors of lymphatic filariasis (Tiwary*et al*., 2007) at the side the carrier of other illness causing pathogens like West Nile Infection (WNY), Ross Waterway Infection, Japanese Encephalitis Infection, St. Louis Encephalitis Infection, Reticuloendotheliosis Infection (Holder, 1999), Murray Valley Encephalitis (Weinstein *et al*., 1997), Reovirus sort 3 and Chikungunya infection (Lee *et al*., 1989; Holder, 1999).

Culexquinquefasciatus is found all over India and accounts for 95% of the entire cases of lymphatic filariasis (Mitchell, 1996). Fruitful usage of this vector control methodologies requires sound information of ovipositional conduct and choice of breeding destinations. *Culexquinquefasciatus* is known to breed in different fake and common water bodies, such as catch-pits, septic tanks, stagnant channels, ground pools and trench, which are constantly made or impacted by man. The point of the show ponder was to get it the oviposition conduct of *Culexquinquefasciatus*collected from the chosen think about destinations of Visakhapatnam area of Andhra Pradesh.

2. MATERIALS AND METHODS

Collection and distinguishing proof of field collected mosquitoes: Both juvenile and develop stages of different mosquito species were collected from chosen think about regions of Visakhapatnam locale, Andhra Pradesh State of India, and were transported to the research facility for mass raising. Chosen think about range had a wealthy and differentiated fauna of mosquitoes and numerous of these species were vectors of different maladies. After collection, mosquitoes were recognized beneath a binocular stereo zoom magnifying lens within the research facility as per the recognizable proof keys. *Culexquinquefasciatus* was liberally found in all most all the chosen think about regions. Hence, all the tests relating to the determination of oviposition medium and inclination for oviposition, F1 offspring of *Culexquinquefasciatus* were utilized.

Mass Rearing of Mosquito Vector

The mosquito colonies were kept up at 26 ± 10C and at a relative mugginess of ~75% beneath a photoperiod of 14:10 h L.D. Hatchlings were nourished a blend of canine roll powder and baker's yeast within the proportion of 2:1. Grown-ups were kept in 30 x 30 x 30 cm Plexiglas cages fitted with cotton surgical stocking tops and kept up on a 10% sucrose arrangement given advertisement libitum.

Oviposition in Response to NaCl Concentration

Reviewed arrangement of NaCl concentrations of explanatory review in dechlorinated tap water by volumetric weakening were tried for oviposition inclination of *Culexquinquefasciatus* mosquitoes. The tried concentration of NaCl was extended from 0.5% to 2.0%. Five-six-day-old females were given a blood supper and exchanged into cages 24" x 24" x 24" in bunches of 100 females per cage. After 48 hours of the blood feast, ovitraps were presented into the cages containing variable concentrations of NaCl and dechlorinated water, which served as control. No positive design of course of action of ovitraps was taken after within the cages. Egg pontoons were collected after egg laying. The try was rehashed 10 times and the information gotten was recorded for advance measurable investigation.

Oviposition in Response to Color of Ovitraps

The arrangement to discover out in case of*Culexquinquefasciatus* mosquitoes having a color inclination for oviposition,

ovitraps were secured with distinctive colored velvet papers such as dark, ruddy, yellow, green, blue, and white plunged half within the water interior to supply damp surface for egg laying by the gravid females, and kept self-assertively interior the cages without any particular grouping of course of action.

Five-six-days-old gravid female *Culexquinquefasciatus*, mosquitoes after a blood supper, in bunches of 100 females per bunch were presented into the cages for oviposition. The egg pontoons were collected when the insectary was kept lit for 12 hours to encourage the females to recognize between distinctive colors of the ovitraps. The try was rehashed ten times and the information so collected was subjected to measurable examination.

Oviposition in Response to Water Collected from Different Sources

Tests were conducted in cages (24" x 24" x 24") to get it the oviposition conduct in reaction to water from distinctive sources beneath controlled natural conditions. Five-six-days-old gravid female *Culexquinquefasciatus* mosquitoes, after a blood dinner, were gathered into 100 mosquitoes per cage independently. After 48 hours of blood feast, circular ovitraps of 4" breadth half-filled with water from diverse normal sources like lake, well, paddy field, deplete, stream and tap water were presented arbitrarily into the cages. The numbers of egg flatboats laid by female mosquitoes were tallied. Ten duplicate tests were conducted and the information gotten was recorded for measurable investigation.

Oviposition in Response to Ovitraps with Larva Holding Water

In this test, in arrange to discover out on the off chance that the gravid female *Culexquinquefasciatus* have any inclination for egg laying in water holding hatchlings or water without any hatchlings, one hundred blood-fed female *Culexquinquefasciatus* mosquitoes per cage were kept in cages of measurement of 24" x 24" x 24". Ovitraps containing 10, 20 and 40 hatchlings independently and ovitraps with as it were dechlorinated tap water were self-assertively presented into the cages. The try was rehashed ten times and the numbers of egg pontoons laid were recorded. The information was subjected to measurable investigation.

Oviposition in Response to Ovitraps Size

Blood-fed gravid female *Culexquinquefasciatus*, 100 per group, were exchanged into cages. In arrange to discover out the inclination of the *Culexquinquefasciatus* mosquitoes for egg laying in the event that any, with regard to the estimate of ovitraps, ovitraps of diverse breadths extending from 6.0 cm to 12.0 cm were kept interior the cages without any clear course of action or arrangement. The number of egg pontoons laid in each ovitrap was checked. The exploration was rehashed 10 times, and the information obtainedwas subjected to assist factual examination.

Statistical Analysis

Information was computed for implies, standard blunder and encourage examination of change (ANOVA) utilizing the factual program bundle (SPSS) 17.0 adaptation.

3. RESULTS

In arrange to get it the oviposition conduct of field collected *Culexquinquefasciatus*, tests were conducted in connection to changed NaCl concentration, choice of ovitrapcolour, choice of oviposition with water collected from distinctive sources, hatchling holding water and measure of ovitrap within the show examination.

Choice of Oviposition with Varied NaCl Concentration

Distinctive concentrations of NaCl arrangements from 0.5% to 2.0% were tried to get the oviposition inclination of *Culexquinquefasciatus*. The display examination uncovers that *Culexquinquefasciatus* females favored the ovitraps containing refined water without NaCl for oviposition and there was no egg pontoons found in ovitrap containing 2.0% Nacl arrangement. Result shows that there was a dynamic diminish within the oviposition action of female *Culex* mosquitoes in a dosage subordinate manner with the increment within the concentration of NaCl (Fig.1), which shows negative relationships between the number of egg pontoons laid by the female and the concentration of NaCl within the oviposition medium.

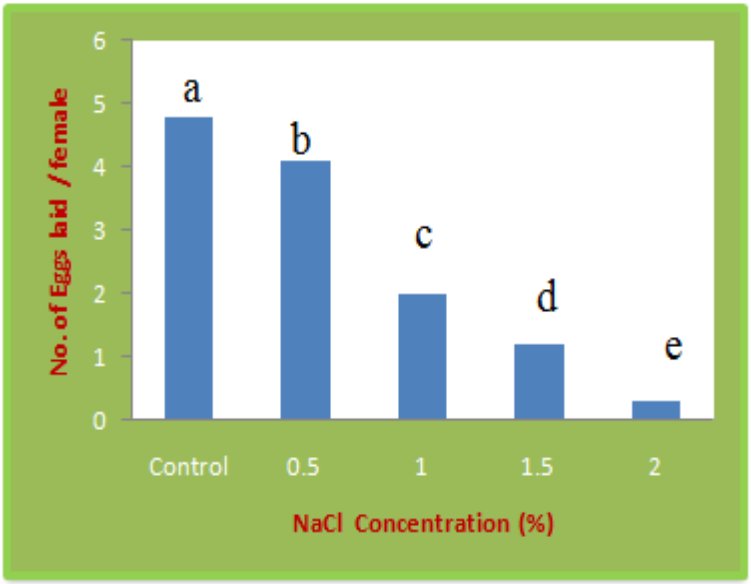

Figure 1: Effect of NaCl Concentration of Oviposition of Wild *Culexquinquefasciatus*. Mean ± SE followed by Same Letter in a Column are not Significantly different at P≤0.05 Level (ANOVA followed by LSD post-test), n=10

Choice of Colourovitraps for Oviposition

Oviposition of female *Culex* mosquito in connection to the colour of the ovitrap was found out and critical impact of colour on the oviposition was taken note. The information within the current think about reflects that *Culex* mosquito favored dark colourovitrap and blue colour was the slightest favored one, as displayed in Fig.2.

The egg flatboats laid by the female *Culexquinquefasciatus*were totally different colored ovitraps, with the diminishing arrange inclination of white, green, yellow, ruddy and blue.

Choice of Water from different Sources for Oviposition

Tests were embraced to get it the oviposition conduct of *Culexquinquefasciatus*, completely different ovitraps with water tests collected from distinctive sources like tap, well, lake, waterway, paddy field and deplete.

The come out of the show ponder have shown that, the foremost favored ovitrap was the water of paddy field and taken after by the diminishing arrange of lake, tap water, deplete and waterway (Fig.3). There was not factually diverse in egg laid by the female in deplete and waterway water. It was taken note that, *Culex* mosquito did not favor the water collected from well for oviposition.

Choice of Larva Holding Water for Oviposition

Entomological examinations were made within the current ponder to get it the influence of larval nearness within the water of the ovitrap for oviposition by the female grown-up *Culex* mosquito. Five-six days ancient developed gravid female *Culexquinquefasciatus* were permitted for oviposition within the ovitraps containing refined water and water with 10, 20 and 40 hatchlings of same species, independently. It was watched that there was an exceptional factually critical distinction in egg laying action of *Culexquinquefasciatus.*

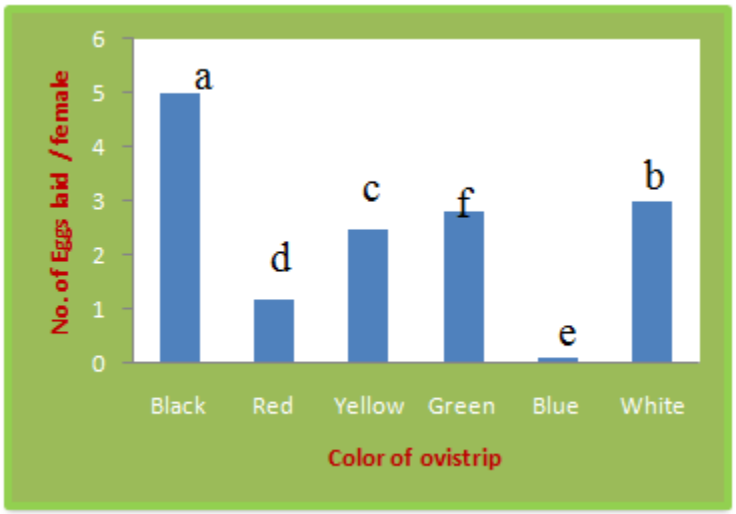

Figure 2: Oviposition Preference of Wild *Culexquinquefasciatus* for different Coloured Ovitraps. Mean ± SE followed by Same Letter in a Column are not Significantly different at P≤0.05 level (ANOVA followed by LSD post-test), n=10.

The female mosquitoes laid greatest number of egg pontoons within the hatchling holding water than as it were refined water (Figure 4).

Choice of Ovitraps Size for Oviposition

Ovitraps with distinctive surface region (breadth in cm) changes from 6.0 to 12.0 cm were taken to ponder the inclination of the oviposition of *Culexquinquefasciatus* with regard to diverse estimate of the ovitraps. All the ovitraps are filled with dechlorinated tap water to supply oviposition surface at the time of test.

It was watched that the most extreme numbers of egg pontoons were laid within the biggest ovitraps taken, and the number continuously decreased with the diminish within the surface region of the ovitraps that shows positive relationship between the estimate of the ovitraps and number of egg flatboats laid (Fig. 5).

4. DISCUSSIONS

Choice of an fitting oviposition location features an incredible impact on maternal regenerative victory in species with sea-going larval and pupae stages (Millar *et al*., 1994).This is since a few variables of the water, both physical and chemical, impact bring forth victory and larval survival (Resetarits Jr. and Wilbur, 1989).Therefore, mosquitoes have a solid choice for separation of potential oviposition locales based on sibling practicality (Petranka and Fakhourry, 1991).

Impact of NaCl on Oviposition Behaviour

Within the display examination, the creators were slanted to think about the oviposition reaction of female

Culexquinquefasciatus mosquitoes to arrangement containing diverse concentrations of NaCl. It was watched that greatest number of egg pontoons were laid by *Culexquinquefasciatus* females in refined water and steadily decreased with an increment within the concentration of NaCl which is in understanding with the discoveries of Anne Hudson (1956) on *Culexmolestus.* In any case, Wallis (1954, 1955) detailed that 0.5% NaCl arrangement was favored over refined water for oviposition by *Aedes* mosquitoes. It may be concluded that *Culexquinquefasciatus* mosquitoes have inclination for ordinary water than the saline water for the oviposition medium for oviposition.

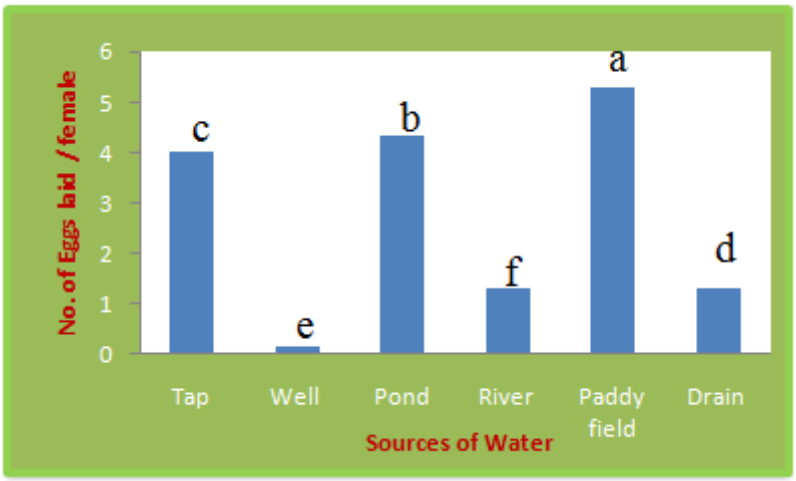

Figure 3: Oviposition Preference in Water from different Sources by Wild Culexquinquefasciatus. Mean ± SE followed by same Letter in a Column are not significantly different at P≤0.05 Level (ANOVA followed by LSD post-test), n=10.

Effect of Container color on Oviposition Behaviour

Holder color was imperative in affecting the oviposition choices of a few female mosquitoes breeding in fake holders. In arrange to discover out in case ovipositing *Culexquinquefasciatus* have any choice for the color of the medium for oviposition, it was chosen to utilize six diverse colored ovitraps to ponder their oviposition conduct.

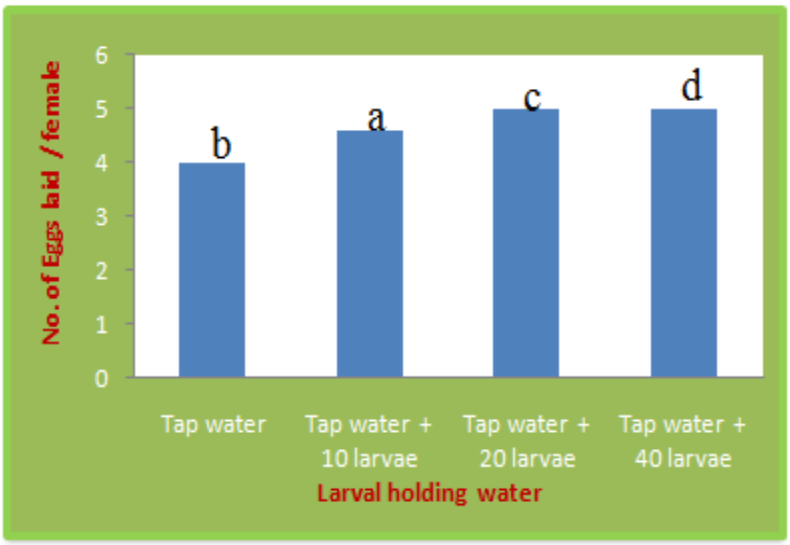

Figure 4: Oviposition Preference of Ovitraps with Larva Holding Water by Wild Culexquinquefasciatus. Mean ± SE followed by Same Letter in a Column are not Significantly different at P≤0.05 Level (ANOVA followed by LSD post-test), n=10

It was taken note that the most extreme number of egg flatboats were laid on dark ovitrap, which is comparable to the discoveries of Panigrahi*et al*., (2014) on *Aedes* mosquitoes. Comparative perceptions were moreover made in different mosquito species by Williams, 1962; Wilton 1968; Mc Daniel *et al*., 1976; Yap and Foo, 1984; Beehler*et al*., 1992; Jones and Schreiber, 1994; Yanoviak 2001; Colton *et al*., 2003. In any case, Badamasi*et al*., (2008) detailed that ruddy being the foremost alluring color, taken after by brown, dark, blue, purple, pink, yellow and white by certain mosquito species. In advance, it has been detailed that both dark and ruddy holders acted as oviposition stimulant and attractant for Toxorhynchites Amboinensis females (Collins and Blackwell2000). Prior reports of Hilburn*et al*., (1983) and Jones and Schreiber, (1994) recommended that mosquito species prefers other color within the nonappearance of dark colored holder for oviposition.

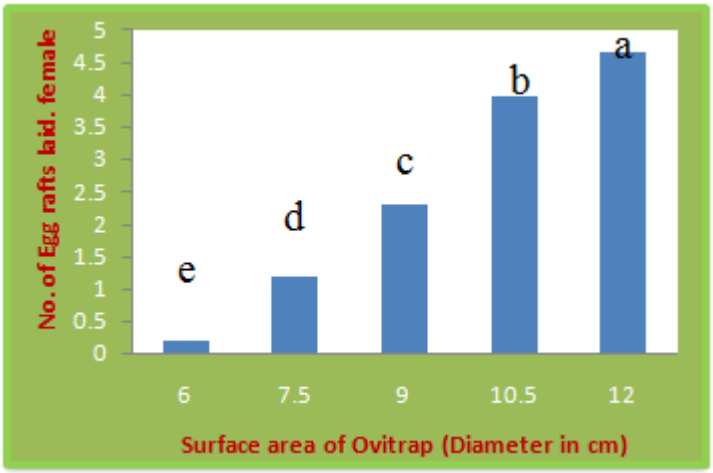

Figure 5: Oviposition Preference by Wild Culexquinquefasciatusin Response to Size of the Ovitrap. Mean ± SE followed by Same Letter in a Column are not Significantly different at P≤0.05 Level (ANOVA followed by LSD post-test), n=10

Influence of Water Collected from Different Sources on Oviposition behaviour

Within the display ponder, greatest number of egg rafts were found within the ovitrap contained water of paddy field taken after by the water of lake, tap, deplete and river but no egg flatboats were laid within the well water which is in differentiate to the discoveries of our past report of Panigrahi*et al*., (2014) where most extreme number of eggs were laid by female *Aedes* mosquitoes in refined water.

Influence of Larva Holding Water on Oviposition Behaviour

Survey of writing says that ovipositing females more often not select water with the nearness of life (Bentley and Day, 1989; Lee, 1991) and regularly mosquitoes maintain a strategic distance from oviposition, where interspecific competitors are shown (Blaustein and Kotler, 1993), but are pulled in to destinations where other mosquito hatchlings are shown (Beehler and Mulla, 1995), since the nearness of nonspecific hatchlings may give a dependable signal that the location offers appropriate conditions for larval improvement (Stav*et al*., 1999).

Within the show try as well, the gravid females of *Culexquinquefasciatus* favored larval holding water over refined water for oviposition, which is additionally comparable to the discoveries of Panigrahi*et al*., (2014) on *Ae. albopictus* and *Ae. aegypti*. Be that as it may, oviposition of female *Culexquinquefasciatus* was not factually distinctive in ovitrap having 10, 20 and 40 larvae of same species within the current think about can be due to the repellent impact of

stuffed hatchlings on oviposition females (Suh *et al*., 2016).

Effect of Container Size on Oviposition Behaviour

In the present study, it was found that *Culexquinquefasciatus* females lean toward bigger surface region of ovitrap than the little ones for oviposition. The number of egg pontoons laid shows a coordinate straight relationship between the surface region of the ovitrap for oviposition, which was comparable to the perceptions made by Derraik and Slaney, (2005) and Panigrahi*et al*., (2014). It is accepted that the bigger holders may give expansive, ensured, sticky resting surfaces for females planning for oviposition (Reiskind and Zarrabi, 2012).

Finally, in bigger holders, the chances of drying up are less and are likely to contain more sum of nourishment and hence are likely to extend the chances of larval survival. In this way it may be concluded that *Culexquinquefasciatus*mosquitoes favor expansive measured holders holding water for oviposition compared to the ones with littler measurements.

5. CONCLUSIONS

The inferences of the display think related to oviposition conduct of *Culex* mosquito has gigantic scope to plan and create compelling oviposition attractants for utilize in catching mosquito species, for the administration of mosquito borne diseases.

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REFERENCES

1. Anne Hudson, B.N. (1956). The behaviour of the female mosquito in selecting water for oviposition. Journal of Experimental Biology, 33:478-492.
2. Badamasi, M.Z., Adamu, T., Bala, A.Y. (2008). Species abundance and colourpreferencesofoviposition by mosquitoes in man-made containers under field conditions inSokoto, Nigeria. Nigerian Journal of Basic and Applied Sciences, 16(2): 193-196.
3. Beehler, J., Lohr, S., De Foliart, G. (1992). Factors influencing oviposition in Aedestriseriatus (Diptera: Culicidae). The Great Lakes Entomologist, 25(4): 259-264.
4. Beehler, J.W., Mulla, M.Y.S. (1995).Effects of organic enrichment on temporal distribution and abundance of Culicine egg rafts. Journal of the American Mosquito ControlAssociation,11(2 Pt 1):167-71.
5. Bentley, M. D., Day, J. F. (1989). Chemical ecology and behavioural aspects of mosquito oviposition. Annual Reviews of Entomology, 34: 401-421.
6. Blaustein, I., Kotler, B.P. (1993). Oviposition habitat selection by the mosquito, Culisetalongiareolata: effects of nonspecific's, food and green toad tadpoles. Ecological Entomology, 18: 104-108.512.

7. Collins, L.E., Blackwell, A. (2000). Colour cues for ovipositionbehaviour in Toxorhynchitesmoctezuma and Toxorhynchitesamboinensis mosquitoes. Journal of Vector Ecology, 25(2): 127-35.
8. Colton, Y.M., Chadee, D.D., Severson, D.W. (2003). Natural skip oviposition of the mosquito Aedesaegypti indicated by codominant genetic markers. Medical and Veterinary Entomology, 17: 195-204.
9. Derraik, J.G.B., Slaney, D. (2005). Container aperture size and nutrient preferences of mosquitoes (Diptera: Culicidae) in the Auckland region, New Zealand. Journal of Vector Ecology, 30:73–82.
10. Hilburn, L.R., Willis, N.L., Seawright, J.A. (1983). Analysis of preference in the color ofoviposition sites exhibited by female Toxorhyrchitesr. rutilus in the laboratory. Mosquito News, 43: 302-306
11. Holder P. 1999. The mosquitoes of New Zealand and their animal disease significance. Surveillance 26(4), 12-15.
12. Jones, C. J., Schreiber, E. T. (1994). Color and height affects oviposition site preferences ofToxorhynchitessplendens and Toxorhynchitesrutilusrutilus (Diptera, Culicidae) in the laboratory. Environmental Entomology, 23: 130-135.
13. Kohn M.1990. A survey on indoor resting mosquito species in Phnom, Kampuchea, Folia Parasitological 37(2),165-74.
14. Lee, D.J., Hicks, M.M., Debenhams, M.L., Griffiths, M., Marks, E.N., Bryan, J.H. Russell, R. C. (1989). The Culicidae of the Australasian region. Volume 7. Canberra, Australia: Australian Government Publishing Service 281 pp.
15. Lee SJ.1991.Major factors affecting mosquito oviposition. Chinese Journal of Entomology 6, 23-35.
16. McDaniel, I. N., Bentley, M. D. Z, Lee, H. P., Yatagai, M. (1976). Effects of Color and Larval-produced Oviposition Attractants on Oviposition of Aedestriseriatus. Environmental Entomology, 5 (3) : 553-556.
17. Millar JG, Chaney JD, Beehler JW, Mulla MS. 1994. Interaction of the Culexquinquefasciatusegg raft pheromone with a natural chemical associated with oviposition sites. Journal of the American Mosquito Control Association 10, 374-379.
18. Mitchell CJ. 1996. Environmental management for vector control. In: The Biology of Disease Vectors (B.J.Beaty&W.C Marquardt, eds.),492-501. Niwot: University Press of Colorado.
19. Panigrahi, S. K., Barik, T. K., Mohanty, S., Tripathy, N. K. (2014). Laboratory evaluation ofoviposition behavior of field collected Aedes mosquitoes. Journal of Insects ArticleID 207489.
20. Petranka JW, Fakhourry K. 1991: Evidence of a chemical mediated response of ovipositing insects to bluegills and green frog tadpoles, Copeia 19, 273-279.
21. Piyaratnea, MK, Amerasinghe, F.P., Amerasinghe, P.H., Konradsen. F. (2005)physicochemical characteristics of Anophelesculicifacies and Anophelesvaruna breeding water in a dry zone stream in Sri Lanka. Journal of Vector Borne Diseases42: 61-67.
22. Reiskind, M.H., Zarrabi, A.A. (2012). Water surface area and depth determine ovipositionchoice in Aedesalbopictus (Diptera: Culicidae). Journal of Medical Entomology,49(1): 71–76.

23. Resetarits, W.J. Jr., Wilbur, H.M. (1989). Choice of oviposition site by Hylachrysoscelis: Role of predators and competitors. Ecology, 70(1): 220–228.

24. Stav,G., Blaustein, L. Margalith, J. (1999). Experimental evidence for predation risk sensitive oviposition by a mosquito, Culisetalongiareolata. Ecological Entomology. 24: 202-207.

25. Suh, E., Choe, D.H., Saveer, A.M., Zwiebel, LJ.(2016).Suboptimal larval habitats!modulate oviposition of the malaria vector mosquito Anophelescoluzzii. Plos one. 11(2), e0149800.

26. Thankachan M, Gopinath A.2017. Diversity of mosquito species in plantation areas of mananthavady, wayanad district of Kerala. International Journal of Mosquito Research 4(2), 24-26.

27. Tiwary M, Naik SN, Tewary DK, Mittal PK, Yadav S,2007, Chemical composition and larvicidalactvities of the essential oil of Zanthozylumarmatum DC (Rutaceae)against three mosquito vectors. Journals of Vector Borne Diseases 44,198-204.

28. Wallis, R.C. (1954). The effect of population density and of NaCl concentrations in test series in laboratory experiments with ovipositing Aedesaegypti. Mosquito News, 14: 200-204.

29. Wallis, R.C. (1955). A study of the oviposition activity of three species of Anopheles in the laboratory. The American Journal of Tropical Medicine and Hygiene, 4(3): 557-563.

30. Weinstein, P., Laird, M., Browne, G. (1997). Exotic and endemic mosquitoes in New! Zealand as potential arbovirus vectors. Wellington, Ministry of Health.

31. Williams, R.E. (1962). Effect of coloring oviposition media with regard to the mosquito Aedestriseriatus (Say). Journal of Parasitology, 48: 919-925.

32. Wilton, D.P. (1968). Oviposition site selection by the tree-hole mosquito, Aedestriseriatus (Say). Journal of Medical Entomology, 5(2): 189–194.

33. World Health Organization. (2014). Vector-borne diseases. Factsheet No.387.

34. Yanoviak, S.P. (2001). Container color and location affect macro invertebrate community structure in artificial tree holes in Panama. Florida Entomologist, 84(2): 265-271.

35. Yap, H.H., Foo, A.E.S. (1984). Laboratory studies on the oviposition site preference of Toxorivnchites splendens (Diptera: Culicidae). Journal of Medical Entomology, 2: 183-187.