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Eco-friendly control of larvae of mosquito using the larvivorous Guppy fishes, *Poecilia reticulata*

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Abstract

The spreading of malaria, yellow fever, dengue fever, chikungunya ferver, filariasis, encephalitis, West Nile Virus infection, *etc* by mosquito is mainly due to the ever increasing urbanization and associated anthropogenic activities. The application of chemical insecticides in mosquito control has resulted in the persistence and accumulation of non-biodegradable chemicals in the ecosystem, biological magnification through the food chain, insecticide resistance, and a toxic effect in human health and non-target organisms. So, under the mosquito fish Guppy, *Poecilia reticulata*, emphasis was given on the application of alternative strategies in mosquito control. Larvivorous guppies fish were collected from swage drain and were employed the biocontrol agents to control mosquito vectors under glass aquarium conditions. These were showed potentiality of a biological control agent over the all types of mosquito larvae. The average consumption rate was much high per day per fish when male and females fishes were applied on the experiments. The feeding activity was more higher at morning and female fish was more active (60%) than male. It was found that choice as a source of food, the guppies' higher preference for *Culex* than *Anopheles* larvae. It was also noticed that female fishes eat up their offspring. The author showed also that these fishes are heavily adapted at collected polluted water from drain of Barasat municipality, North 24 Parganas, West Bengal and survives in all types of water bodies. It was noticed that these exotic hardy larvivorous fishes can survive a wide range of pH from 6.0 to 9.5. Mature fish female fishes reproduces throughout the year after 25- 30 days interval under the temperature from 20^0C to 35^0C. It will be easy to plan a cost-effective control tools at various submerged water bodies, drain, small ponds etc against mosquito young instars.

Keywords: Biocontrol, guppy fish, larvicidal, mosquito.

Introduction

India's population suffers from a significant disease burden from vector-borne diseases, in the form of morbidity and mortality from malaria, kala-azar, filariasis, Japanese encephalitis and dengue. To check the disease, extensive measures are made for mosquito control and more than 50,000 tons of chemical insecticides are used annually (WHO, 2009). These chemicals have nevertheless, considerable toxic and environmental risks. Use of pesticides can result in increase in contamination of soil and water. Being non selective, they kill together with the target insects, many beneficial organisms including the natural enemies of mosquito larvae, and disrupt the ecological balance. Zhang et al., 2011 reported that the continuous use of chemical-based insecticides resulted in the development of resistance, detrimental effects on non-target organisms and human health problems. Now a days, it also proved that repetitive use of man-

made insecticides for mosquito control disrupts natural ecosystems and the biological control systems and increase in mosquito populations (Das et al., 2007).

Larvivorous fishes were the first biocontrol agents employed to control mosquito vectors. Fish have been used in many countries for malaria control by controlling vectors. Of these the common varieties utilized as biocontrol agents are the mosquito fish (*Gambusia affinis*), Guppies (*Poecilia reticulata*), *Aplocheilus blochii, Macropodus* and a variety of other local and indigenous fishes as per their availability in the local habitat (Madhu and Sarkar, 2015).

So, author hardly believe that this problem can be tackled 50-60% by large-scale cultivation of larvivorous fishes for controlling mosquitoes at a certain level due to maintaining the quality and saving our environment. The author also think, need to look at the challenge from a different perspective altogether. Awareness about natural strategies for controlling mosquitoes as a livelihood option through on campaigning and training for students and local peoples is also necessary.

Materials and Methods

The various mosquito larvae were collected from various localities from Barasat Municipality, West Bengal. The colonies of various mosquito larvae were maintained separate glass aquariums within 3 inches water in the laboratory at a temperature of 25°C with a relative humidity of 75 ± 5% and 14 h of photoperiod. Mosquito larvae were identified by experts and maintained them according to their Genus viz., *Culex* and *Anopheles*. The larvae of various mosquito larvae were maintained in separate four glass aquariums (30" x 20" x 30") as per the standard method. All the glass aquariums were covered by nylon mosquito net. The larvae were fed daily with fish food dust until experiments. The experiments were performed in the external area on the month of March, 2017 to February, 2018 of the Acharya Prafulla Chandra College, Kolkata-700131, West Bengal, India.

On the other hand, guppy fishes (Male & female, *Poecilia reticulata)* were culture within a big cemented tank about 100sq.ft area. These were primarily collected from swage drain of Barasat drain, West Bengal. Fish were fed daily on fish grain food collected from local market. About 2000 numbers of guppy fishes were reared within the tanks in all seasons. When their numbers were increased largely, they were transferred to college pond, local small ponds, drains etc.

Test for efficiency of guppy fishes:

There are six types experiment were arranged for examining the performance of the larvivorus fishes for *Culex* and six types for *Anopheles* mosquitoes. Every experiments also have six numbers replica. Mature male and female fishes were separated from the cemented tank and maintain a separate clean glass aquarium without providing them any fish food (3 hours) before the experiments.

Experiment-I: One male and one female guppy fishes were employed the biocontrol agents to control of 3rd instar larvae of mosquito under small glass aquarium (12" x 8" x 6") conditions at morning 9:00 AM, 12:00 Noon, 4:00 PM & 7:00 PM.

Experiment-II: Two male and two female guppy fishes were employed the biocontrol agents to control of 3rd instar larvae of mosquito under small glass aquarium (12" x 8" x 6") conditions at morning 9:00 AM, 12:00 Noon, 4:00 PM & 7:00 PM.

Experiment-III: Two male and one female guppy fishes were employed the biocontrol agents to control of 3rd instar larvae of mosquito under small glass aquarium (12" x 8" x 6") conditions at morning 9:00 AM, 12:00 Noon, 4:00 PM & 7:00 PM.

Experiment-IV: one male and two female guppy fishes were employed the biocontrol agents to control of 3rd instar larvae of mosquito under small glass aquarium (12" x 8" x 6") conditions at morning 9:00 AM, 12:00 Noon, 4:00 PM & 7:00 PM.

Experiment-V: one male and none female guppy fishes was employed the biocontrol agents to control of 3rd instar larvae of mosquito under small glass aquarium (12" x 8" x 6") conditions at morning 9:00 AM, 12:00 Noon, 4:00 PM & 7:00 PM.

Experiment-VI: None male and one female guppy fishes was employed the biocontrol agents to control of 3rd instar larvae of mosquito under small glass aquarium (12" x 8" x 6") conditions at morning 9:00 AM, 12:00 Noon, 4:00 PM & 7:00 PM.

Results

Fishes were fed daily on 3rd instar larvae of *Culex* and 3rd instar of *Anopheles*. 100 numbers of these larvae were used for each experiments under 10 minutes duration. Each experiment (fish x larvae) was repeated six times without repeating fish. During the experiments, there were none fish died.

Table 1. Performance of male and female Guppy fishes (in various ratio) for *Culex* and *Anopheles* larvae in different time zones.

Experiments	Male: Female fishes	No. of *Culex* larvae consumption (Mean ± SE)				No. of *Anopheles* larvae consumption (Mean ± SE)			
		9:00 AM	12:00 NOON	4:00 PM	7:00 Pm	9:00 AM	12:00 NOON	4:00 PM	7:00 Pm
I	1:1	27.67± 1.38	25.83± 1.83	26.67± 2.17	10.50± 1.38	25.17± 2.24	22.00± 1.59	24.50± 1.86	11.67± 1.12
II	2:2	35.17± 1.76	31.17± 2.80	33.17± 1.96	17.17± 1.66	27.67± 2.17	25.67± 1.89	25.83± 1.64	10.17± 1.05
III	2:1	29.83± 2.15	27.17± 1.96	27.68± 1.82	15.67± 1.45	28.50± 2.13	26.83± 1.70	28.00± 1.86	13.33± 1.09
IV	1:2	38.17± 2.36	32.67± 1.95	35.67± 2.99	18.83± 1.78	33.33± 2.63	30.33± 2.17	30.83± 2.98	14.50± 0.92
V	1:0	21.33± 1.89	20.50± 1.34	20.33± 1.28	9.16± 0.65	18.33± 1.86	16.67± 1.65	15.83± 1.35	9.50± 0.67
VI	0:1	21.17± 2.48	23.17± 1.35	24.50± 1.73	12.50± 1.06	19.83± 1.74	14.17± 1.22	17.67± 1.84	11.00± 0.58
* SE = Standard Error									

Test for survival and reproduction:

About ± 80 days, guppy fishes developed into adult stages. Females gives birth offspring 4-8 numbers at a time and approximately ±20 times birth of a matured female guppy fishes of her life cycles after 25-30 days intervals. Both males and females (50 males & 50 females) were tested various types of polluted water in separate glass aquarium for 7 days which were collected from various location of drainage water of Barasat Municipality. Minimal water analysis parameters were done (pH and temperature) also. Surprisingly, they can breed between the pH of 6.0 to 9.5 and temperature of 20^0C to 35^0C. During winter temperature below 10^0C, they cannot breed properly. They survive easily within these both wide range of variations. During the experiments, there are none fish died.

Figure 1-4. Authors is doing his research on performance of Guppy fishes using mosquito larvae in the external area of Acharya Prafulla Chandra College, Kolkata-700131.

Discussion and Conclusion

The present study was sort to scientifically evaluate the larvivorous activity of Guppy fishes, *Poecilia reticulata*. These fishes were used for controlling mosquito larvae and their efficacy was proved by these simple experiments. First of all, all the six experiments showed guppy fishes fed large numbers of mosquito larvae (both the *Culex* and *Anopheles*). The feeding activity was highest at morning and female fishes were fed more larvae than male. Feeding activity levels were also increased when male and females were applied together on the experiments. As a result, average consumption rate was much high per day per fish. Females were also showed more carnivorous activities than females. Females guppy fishes ate their offspring also. It was found that choice as a source of food, there was greater preference towards mosquito larvae of *Culex* species than *Anopheles* larvae. As per their experimental performance and activity against mosquito young instars, guppy fishes should be distributed to all suitable villages supported by activities to encourage people to inform and educate them on keeping the fish is an environment friendly method of control of mosquitoes. Author also found on field trial that Guppy can control approximately 50-55%. Lastly it is concluded that none of the single strategies is fully successful for mosquito control. Novel eco-friendly strategies to manage mosquito vectors are urgently needed.

Conflict of Interest:

The authors declare that there is no conflict of interest.

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