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Potential of the ornamental fish, *Trichopodus trichopterus* (Pallus, 1770) in controlling *Culex* larvae under laboratory condition

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ABSTRACT

The three spot gourami, *Trichopodus trichopterus*, an ornamental fish, consumed significantly more larvae of *Culex quinquefasciatus* than *Culex quinquefasciatus* pupae and *Chironomus ramosus* larvae irrespective of whether those were offered as prey separately or together in paired combination. This fish predates significantly more number of prey during day time and has significantly higher dietary preference index for *Culex quinquefasciatus* larvae as compared to *Culex quinquefasciatus* pupae or *Chironomus ramosus* larvae. It appears to a very efficient biocontrol agent at least under laboratory condition.

Key words : Biocontrol, *Chironomus ramosus* larvae, *Culex quinquefasciatus* larvae and pupae, dietary preference, larvivorous fish, *Trichopodus trichopterus*.

INTRODUCTION

Fish are more effective controlling agents of the mosquito larvae as compared to copepod predators (Russell *et al*., 2001) and unlike chemical larvicides mosquito larvae cannot make themselves physiologically resistant to fish (Rodríguez-Pérez *et al*., 2012). Larvivorous fish are being used in control of mosquito from pre-DDT era (Walker and Lynch, 2007). Raghabendra *et al*. (2011) have enlisted common mosquito feeding fishes of India. In recent years several papers have been published on the mosquito larvae feeding ability of fishes in India (Phukon and Biswas, 2011, 2013; Bano and Serajuddin, 2016; Das *et al*., 2018; Pahari *et al*., 2020 a & b) and elsewhere (Cavalcanti *et al*., 2007; Seng *et al*., 2008; Rodríguez-Pérez *et al*., 2012; Oo *et al*., 2018). Three spotted gourami, *Trichopodus trichopterus* (Pallus, 1770) is one of the hardiest fish which can adapt in different water conditions (Sandford, 1999) and in nature it inhabits lowlands, wetlands, marshes and swamps (Kottelat, 2001). Cavalcanti *et al*. (2007) experimentally demonstrated that it is an efficient predator of *Aedes aegypti* larvae. In the present paper *Culex quinquefasciatus* larvae and pupae feeding ability of this fish has been investigated under laboratory condition to evaluate its biocontrol potentiality.

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MATERIALS AND METHODS

T. trichopterus specimen were collected from a ornamental fish breeding centre of Tamluk. These were gently placed in a glass aquarium containing filtered pond water and acclimatized for a fortnight before the commencement of experiments. Mosquito larvae and pupae were collected from the drainage system of Tamluk Municipality region. The larvae and pupae were captured by a hand net (mesh size 200 μm). These were transported to the laboratory and kept in an aquarium filled with drain water. *Culex quinquefasciatus* Say, 1823 larvae and pupae were identified following Tyagi *et al*. (2015) sorted out and stocked in another aquarium for use in experiments. *Chironomus ramosus* Choudhuri *et al*., 1992 were also collected from the drainage system of Tamluk municipality region along with the sediments using trays and baskets, transported and stocked in laboratory.

Two glass aquaria (30 × 20 × 24 cm) were filled each with 6 lit of pond water after passing through a plankton net (mesh size 62 μm) the day before every experiment. Acclimatized fish of approximately similar weight (9.37 - 9.63 g) and length (9.32 - 9.91 cm) were placed one in each experimental aquarium and starved for 24 h before commencement of experiment which lasted for 24 h from 6:00 h in the morning to 6:00 h next day.

Predation data were recorded at 6 pm (for day time) and 6 am (for night).

Predation efficiency and prey preference were studied by offering prey separately and in paired combination. In the first series in the first set, only *Culex quinquefasciatus* larvae were given as prey in two aquaria each with one fish. In the second set, only *Culex quinquefasciatus* pupae were given as prey in two aquaria each with one fish. In the third set, only *Chironomus ramosus* larvae were given as prey in two aquaria each with one fish. Experiment was repeated for four times. In the second series *Culex quinquefasciatus* larvae and *Chironomus ramosus* larvae were given together as prey in 1:1 ratio in two aquaria each with one fish. Here also experiments were repeated for four times. Data collected were analysed by using MS-Excel 2013 and IBM SPSS version 25 software. Dietary preference index was computed using the formula of Chesson (1978).

$$\hat{\alpha}_i = \frac{\hat{r}_i}{\hat{n}_i}\left[\frac{1}{\Sigma\left(\hat{r}_j/\hat{n}_j\right)}\right]$$

[Where, α_i = Manly's alpha (preference index) for prey type i; r_i, r_j = Proportion of prey type i or j in the diet (i and j = 1, 2, 3….. m); n_i, n_j = proportion of prey type i or j in the environment; m = number of prey types possible]

RESULTS AND DISCUSSION

When *T. trichopterus* was offered prey separately it always consumed significantly more ($p < 0.001$) *Culex quinquefasciatus* larvae as compared to other prey in course of 24 h (Table 1).

The same trend of predation was also observed for day time and night time predation. It was also seen that diurnal consumption was significantly more than the nocturnal predation irrespective of prey type (Table 2).

When prey types were offered together in paired combinations the fish took significantly more *Culex quinquefasciatus* larvae as compared to *Chironomus ramosus* larvae in course of 24 h as well as during day or night (Table 3).

This finding is further supported by the significantly higher dietary preference index of the fish in favour of *Culex quinquefasciatus* larvae (Table 4).

Mosquito larvae feeding ability of various fish species have earlier been investigated by various authors like Cavalcanti *et al*. (2007); Phukon and Biswas (2011, 2013); Bano and Sirajuddin (2016); Oo *et al*. (2018); Pahari *et al*. (2020a & b). Present study revealed that *T. trichopterus* is a predominantly diurnal predator consuming significantly more

Table 1. Predation rate in 24 hrs. of *T. trichopterus* when prey types were offered separately.

Prey type	No. consumed [Mean ± SE (Range)]	Comparison	t value ($p < 0.001$)
Culex larvae (ML)	819.88 ± 6.91 (793-852)	ML vs MP	6.32
Culex pupae (MP)	776.63 ± 6.17 (753-802)	ML vs CL	19.92
Chironomus larvae (CL)	647.75 ± 7.17 (628-677)	MP vs CL	24.24

Table 2. Predation rate during day (12 h) and night (12 h) of *T. trichopterus* when prey types were offered separately.

Prey type	Number consumed [Mean ± SE (Range)]		t value ($p < 0.001$)
	Day (6 am - 6 pm)	Night (6 pm - 6 am)	
Culex larvae (ML)	472.88 ± 4.31 (459-494)	408.88 ± 4.02 (391-424)	10.85
Culex pupae (MP)	457.13 ± 4.45 (441-476)	389.25 ± 4.73 (373-412)	10.45
Chironomus larvae (CL)	430.38 ± 3.91 (417-446)	368.75 ± 4.13 (353-387)	10.83

Table 3. Predation rate during day and night of *T. trichopterus* when prey types were offered in paired combination.

Predation time	*Culex quinquefasciatus* larvae consumed [Mean ± SE (Range)]	*Chironomus ramosus* larvae consumed [Mean ± SE (Range)]	t value ($p < 0.001$)
Day (6 am - 6 pm)	253.13 ± 3.80 (241-272)	208.50 ± 3.99 (192-227)	8.10
Night (6 pm - 6 am)	227.38 ± 3.84 (212-246)	192.75 ± 3.28 (179-204)	6.85
24 h	490.88 ± 6.08 (471-518)	396.63 ± 5.54 (378-421)	11.46

Table 4. Comparison of the dietary preference index of *T. trichopterus*.

Predation time	*Culex quinquefasciatus* larvae	*Chironomus ramosus* larvae	t value (p < 0.001)
Day (6 am - 6 pm)	0.55	0.45	13.68
Night (6 pm - 6 am)	0.54	0.46	10.19
24 h	0.55	0.45	12.16

prey during day as compared to night. Similar observations have also been made by Phukon and Biswas (2011) for *Chana gachua* and Pahari *et al*. (2020b) for *Stigmatogobius sadanandio*. It appears that *T. Trichopterus* relies more on the visual cues for predation.

Presence and absence of alternative prey adversely affect the mosquito larvae predation ability of a fish. Predatory fish generally seek large and agile prey (Knight *et al*., 2004; Manna *et al*., 2008). Devi and Juhari (2011), Barik *et al*. (2018) and Pahari *et al*. (2020a & b) have demonstrated the predatory fish have a definite preference for *Chironomous* larvae over *Culex quinquefasciatus* larvae. Unlike mosquito larvae, which live mostly at surface in stagnant water, chironomid larvae live at the bottom or on submerged plants and objects (Bay, 2003). Pahari *et al*. (2020a, 2021) have experimentally demonstrated that the predation ability of *Puntius sophore* and *Colisa fasciata*, changes from *Chironomous* larvae to *Culex* if the nature of the substratum is made more complex. In the present investigation it has been found that *T. Trichopterus* always preferred *Culex quinquefasciatus* larvae than other types of prey. However, there was a relative decline in the predation rate in presence of alternate prey. Similarly presence of additional predators also adversely affects the biocontrol efficiency of a predatory fish (Saha *et al*., 2010; Pahari *et al*., 2018).

It may thus be concluded that as *T. Trichopterus* is an efficient predator of *Culex quinquefasciatus* larvae, even in the presence of alternate prey, it may be effectively used in mosquito biocontrol management programme.

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