International Journal of Current Science Research
www.drbgrpublications.in

Volume: 2; Issue: 1; January-2016; pp 239-251. ISSN: 2454-5422

Chironomus larvae culture –A boon to Aquaculture sector

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Abstract

The *C.ramosus* larvae were selected for the present study. Four types of organic nutrient manure were prepared viz; cow dung, vegetable waste, duck waste and rice bran. Each organic manure weight range from 5, 10,15g dissolved in 10 lt of dechlorinated water. Among the organic manure the cow dung (15) g displayed the following parameters, no of eggs was 286.66 ±1.24,Hatchability 96.66±4.71 and the fly emergence is 15.0 ±0.816 days, survival rate was 100% and followed other organic manure. Due to the organic manure variation, the larval periods also ranged from 14-19 days were observed. The life cycle of the species 23 days were recorded respectively.

Keywords*:* *Chironomus ramosus*. rearing, organic manure, life cycle, live feed

Introduction

They are the most abundant and diverse group of aquatic insects. They are found in almost any water body and it is common for Chironomids to comprise more than 50% of the species richness. Some kinds of Chironomids are blood red (this color is list when the specimen is preserved). The red coloration comes from hemoglobin that allows the larvae to store oxygen and survive in situations with low dissolved oxygen.

It is an important food source for insects, fishes and birds. Particle size of the nutrient medium and silt used for construction of the tube determine the efficiency of filtration and growth (Mc Lachlan and Shanmugavelu,1984).Studies on food consumption and growth of

Chironomids have been mostly carried out in the field, where the effect of quality of food can not be easily monitored (Johannson,1980).

The Chironomid larvae and pupae are highly nutritious and nourishing and constitute one of the stable food items in the ration of many fishes in the natural environment. They will greedily devour them, when they are offered and the fish grow faster and spawn earlier. They have been reported in literature to be very adequate for growth in fishes (Johnson, 1929; Ling, 1966; Yashouv, 1970).

The larvae are used as live food for aquarium fishes and carnivorous fish fry in fish culture. Its suitability in this aspect has been well documented (Yashouv, 1956; Ling, 1966; and Yashouv and Shachar, 1967). Larval insects of the family chironomidae or midges are the common and most important natural foods of many fishes. Midges' larvae only occasionally have been reared as food for cultured fish (Sadler, 1935; Konstantinov, 1952, 1954, 1958; Yashouv and Ben Shachar., 1970). The present paper reports on the laboratory growth of *Chironomus ramosus* larvae reared using different organic manure and life cycle of the *species* were recorded.

Material and Methods

The vegetable waste was collected from the local market and dried in our laboratory. It was powdered and sieved with the help of fine mesh and stocked. And the same method was followed in the cow dung waste. Series of culture media were prepared using dry cow dung, vegetable waste, duck waste and rice bran, Freshly hatched larvae from the egg masses incubated at 28 ^{o} c in the laboratory were reared in separate plastic trough with 10 lt of dechlorinated drinking water providing dry cow dung and vegetable waste, duck waste and rice bran powder as a nutrient source. Each series consisted of about 20 larvae; and all the larvae were hatched from the same egg mass. The larvae were weighed before the commencement of feeding experiment. Initial length and weight of the larvae was .7 mm and .08 mg. To facilitate easy construction of tube the worms were gently aerated. The mosquito net was used to cover the plastic trough fully to prevent the entry of mosquito into the culture system 0.2 g of organic matter free soil (particle size .1 mm^3 was provided as a substratum.

The nutrient source weight ranged from 5, 10, and 15 g of cow dung dry powder and the same weight was followed in the vegetable waste dry matter, duck waste and rice bran (All were dried and powdered). Each one of the experimental set up was maintained in triplicate. Daily two times morning and evening the nutrient extract was supplied from the different weight of the organic manure, and the waste were removed from the extract. The water chemistry values over the duration of the experiment was pH 6.8-7.5, dissolved oxygen 5.8-6.5 mg/lt, temperature 25 ^{o}c-28 ^{o}c and the total ammonia were ≤ 1.0-1.8 mg/lt were monitored for every two days. And every day the culture system was watched for the emergence of midges.

Collection

The Chironomus larvae were collected from in an around of Virudhunagar all through the season especially from the drainage canals and the larvae were carefully transported to zoology research laboratory of V.H.N.S.N College (Autonomous) Virudhunagar.

Rearing

The collected worms were reared in the lab condition, using crude wet cow dung extract as nutrient sources. The water level was maintained throughout the rearing periods. The suspected gravid adult was allowed to lay the eggs in the laboratory; the eggs were left to hatch and thereafter reared up to the adult.

Male Female identification

The male and female identification of the Midges were morphologically differentiated. The Male have the thin abdomen with greenish color and have the plimose type of antenna. The female have broad abdomen with dark color and the antenna have plumose type of antenna. The Male and Female were identified and transferred to the other troughs to lay the eggs, containing the crude cow dung extract mixed with water. The species also identified using the key of Saether (1969) under MV.TEX camera Lucida microscope. The water level was maintained. With in 1 or 2 days, mating took place.

Life cycle

The four life stages, egg, larvae, pupae, and adult, are treated separately. The life history of Chironomus spp has been described by Oliver (1971) and Hill and Cheung (1978).But the detailed study of the different stages of the life cycle of the species in south India has not been done. The developmental stage of the C.ramosus from egg to adult was 23 days as recorded in our laboratory. Effect of different nutrient sources on the growth performance, hatchability, fly emergence and survival rate of ***C. ramosus*** larvae are presented in table 1

Egg mass

The eggs nos of 210 to 240 nos of eggs were recorded from each of the individual breeding set. The sex ratios of 2:1 were allowed in a breeding set. The eggs were collected in the Petri dish and carefully put into another trough containing crude cow dung extract. After 24 hours the young ones were hatched from the same egg mass.

Larvae: I st Instar- 4th instar

First instar larvae were colorless, although later instars are usually red depending on nutrition and oxygenation. The energy required for swimming is obtained by feeding on suspended algae and detritus, but some nourishment may be derived from the yolk that remains from the egg (Alekseyev.1965).

The first instar settled after several days and built a case. First instar larvae could be recovered from the field at this stage in bottom samples. The molt to the second instar followed quite rapidly. In the second instar the single pair of ventral tubules although present was relatively shorter than in 3 rd or 4 th instars. Second and subsequent instars showed strong negative phototaxis, bright directional light even causing them to leave their tubules.

Results

Fig 1. Shows the emergence of midge fly larvae and hatchability of the eggs, survival rate were showed on the chosen nutrient media viz; cow dung, vegetable waste, duck waste and rice bran. Among the organic nutrient sources cow dung fed groups on 15 g medium were first observed to emerge as fly compared to other organic nutrient media. And the hatchability was 96.66%, Days of fly emergence is 15.0±.816 days and the survival rate is 100 and followed by other organic manure were recorded. The metamorphosis took place within the larval tube. However the larval period was prolonged to 18, 16, and 15, days in those reared on (5, 10, and 15 g) cow dung followed by vegetable waste it was 15, 16, and 17 days, duck waste (16, 19, and 19), Rice bran (14, 17 and 16) days respectively. The time of the fly emergence may vary due to the organic manure variation and the survival rates are presented in fig (1)

In the case of rice bran 5 g was enough for the larval rearing of the *C.ramosus*.But other organic manure 15 g was needed suitable for the larval rearing and the no of eggs were varying from one organic manure to others due to certain composition of the manure. From the study we have recorded 15 g is suitable for the rearing of this species in 10 lt of water. If there is organic load in the rearing tank or trough mass mortality will be happens. According to the size and density of the animal we should apply the organic manure. So 15 g medium is suitable for the culture of Chironomus larvae in 10 lt of water. The temperature plays a major role in the larval development of the midge fly larvae. The larval development mainly depends on the temperature. If the temperature falls below 10^o c mass mortality was observed. Before the fly the larvae length ranged from 3.5 cm-4.5 cm, in cow dung nutrient sources. However the duration required for metamorphosis of the larval into pupae and imago did not differ due to difference in the quality of the medium.

Discussion

Among the different organic manure media provided in a series of sets, dry cow dung and vegetable waste in the ratio of 15 g was found to be suitable for maximizing the productivity of Chironomus midges except rice bran. The fact that chicken manure provides a potential nutrient medium for Chironomus culture has been demonstrated by Shaw and mark (1980). At an expense of 1440 kg of Chicken manure about 140 kg of Chironomus larvae were obtained in an area of 675 m^2 in about 50 days.

The best survival and weight gain are presented in table 1.The best weight gain were observed in those reared on the cow dung of 15 g followed by other organic manure ratios. The time of fly emergence may vary from one nutrient source to other one due to certain group of components of the organic manure. The temperature plays a major role in those reared on the different type of organic manure.

Temperature is one of the major factor controlling rates of growth and development in aquatic insects Anderson *et al.,* (1979). And the adult body size of a number of insects depends largely on temperature experienced during larval development Sweeney *et al*., 1978. In addition to a direct effect on metabolism, temperature is also likely to have an indirect effect through its influence on food quality and quantity Sweeney *et al.*, 1978.

But there is evidence that food quality may also have a significant effect Ward *et al*., 1979. Studied growth and development of a range of species at different temperatures, At 15 ^{o} c larval development required between 5 and 48 days for completion Mackey, A.P.1977. Larvae reared at lower temperature are usually longer than those reared at higher temperature. Mackey.A.P, 1977.In our present study, similar results were also observed in the growth and emergence of midge fly. In the present study shows that 15 g cow dung dry powder extract, vegetable waste duck waste can give the best fly emergence within a short period of days than the natural cycle of the Chironomus. In Hong Kong Chironomid larvae are grown on Chicken manure (Shaw and mark, 1980).The yield is about 28 gm $^{-2}$ week$^{-1,}$ which is much lower than the yield of 250 to 375 gm^{-2} week^{-1}obtained by Yashouv (1970) who grew Chironomid larvae on chicken manure in pans within a green house with aeration.

Horse manure has also been used to fertilize the pool for blood worm culture .But the average yield of the best pools was 11gm-2 week-1 which was only a fraction of the maximum yield obtained from other midge's culture systems (Mc Laeney *et. al*., 1974) .The attempt to rear blood worms with various by products such as Wheat bran, rice bran, Soya been meal, Coconut refuse have been carried out with satisfactory results (Koh and Shim, 1980 Teo *et al*., 1985).In our present study also showed the similar results.

Conclusion

The cow dung is easily available one. The farmers, who may not know the use of the bloodworms, may be recommended to start the bloodworm culture within the aqua farm. Since they live in oxygen-depleted area even in the drainage canals their culture is easy. The cow dung extract should be given in the culture system and the water level must be maintained throughout the culture period. This can be done with the fish, side by side the culture going on. We can harvest the worms at the time of maturing period. Larval rearing of bloodworms is very easy in the lab condition. Therefore dry cow dung is considered as a better source of nutrients followed by dry vegetable powder, duck waste and rice bran, for culture of Chironomus larvae. And the local fish farmer may easily culture the "blood worms" using the cow dung extract. which improve the gonad development of the fish especially gold fish and certain group of ornamental fishes.

Acknowledgement

The financial assistance we got from the Science and Engineering Research Board (SERB), New Delhi, is greatly acknowledged. The author is thankful to Secretary and Principal of V.H.N.S.N College (Autonomous) for providing the lab facilities to carry out the work successfully.

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Fig 1.Effect of different organic nutrient sources on the growth performance, hatchability, fly emergence and survival rate of *C. ramosus* larvae in lab condition.

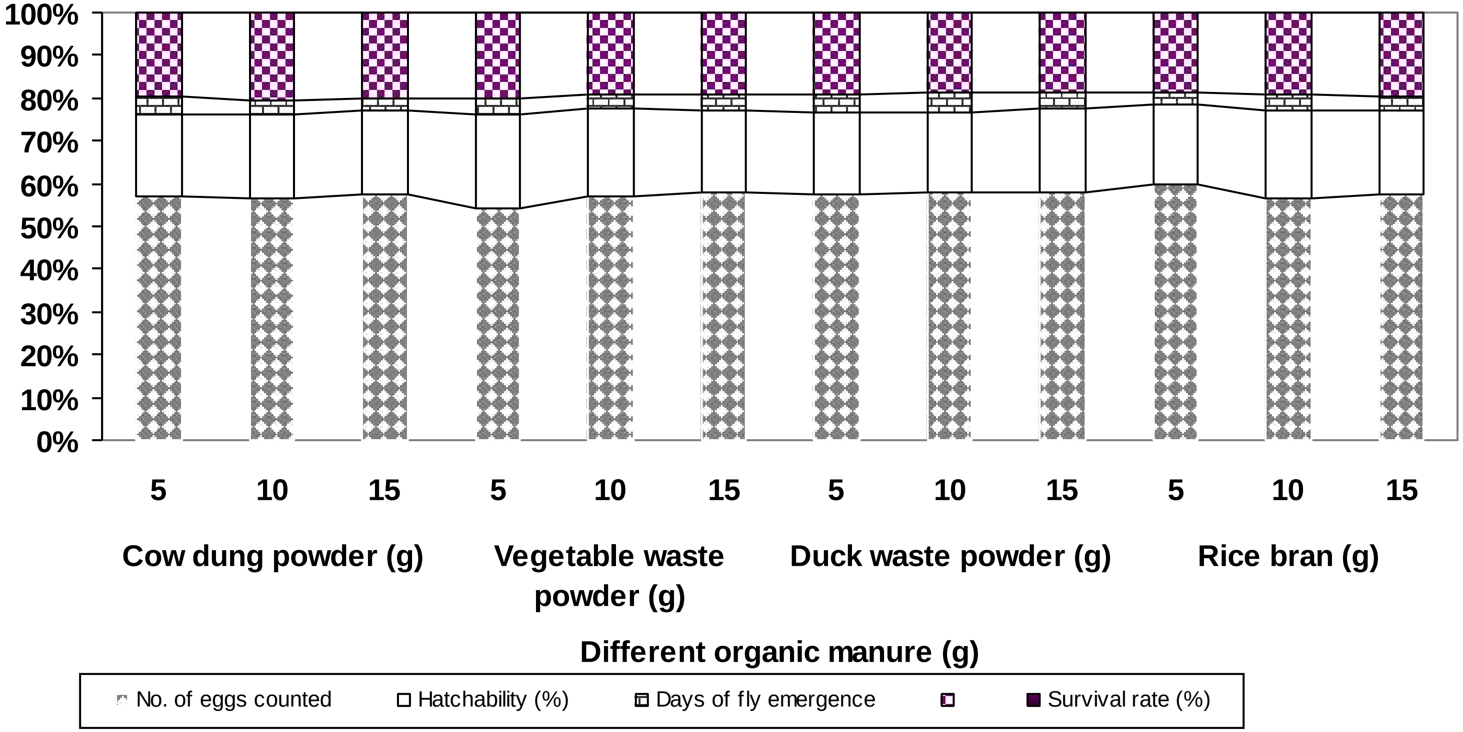

Table1. Effect of different organic nutrient sources on the growth performance, hatchability, fly emergence and survival rate of ***C. ramosus*** larvae in lab condition.

	Nutrient sources											
	Cow dung powder (g)			**Vegetable waste powder (g)**			**Duck waste powder (g)**			**Rice bran (g)**		
	5	**10**	**15**	**5**	**10**	**15**	**5**	**10**	**15**	**5**	**10**	**15**
No. of worms stocked	30	30	30	30	30	30	30	30	30	30	30	30
Temperature	28 ^{o} C	28 ^{o} C	28 ^{o} C	28 ^{o} C	28 ^{o} C	28 ^{o} C	28 ^{o} C	28 ^{o} C	28 ^{o} C	28 ^{o} C	28 ^{o} C	28 ^{o} C
Ammonia	≤1.0	≤1.0	≤1.0	≤1.0	≤1.0	≤1.0	≤1.0	≤1.0	≤1.0	≤1.0	≤1.0	≤1.0
pH	6.7-7.8	6.9-7.5	6.8-7.0	6.8-7.2	6.8-7.0	6.9-7.2	6.8-7.0	6.8-7.0	6.8-7.0	6.8-7.2	6.8-7.0	8.0
DO mg/lt	5.3	5.5	5.6	5.2	5.3	5.6	5.8	5.0	5.3	5.6	5.5	5.7
No. of eggs counted	259.66±5.31	267.66±2.86	286.66±1.2	227.66±2.86	258.33±1.69	268.66±1.69	263.0±1.63	247.33±3.29	277.0±2.16	267.66±2.05	248.33±7.76	77. 3.29
Hatchability (%)	89.5±.70	91.66±6.23	96.66±4.71	90±14.14	95±4.08	90±14.14	86.66±4.71	80±8.16	93.33±9.42	83.33±4.71	88.5±2.121	93.33±4.714
Days of fly emergence	18.0±.816	16.33±1.247	15±.816	17.33±1.247	15.0±.816	16.0±.816	19.66±.471	19.0±.81	18.33±1.24	14.0±.81	17.33±.471	16.66±.942
Survival rate (%)	90±8.164	96.66±4.71	100	83.33±4.71	86.66±12.4	90±8.16	86.66±12.4	80±8.16	90±14.14	83.33±16.9	83.33±16.9	93.33±9.42