

EFFECT OF PHOTOPERIOD(ONE MONTH LIGHT AND ONE MONTH DARK) ON BREEDING PERFORMANCE OF LIVE BEARER ORNAMENTAL FISHES

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Abstract: The present study was conducted to find out breeding performance of live bearer ornamental fishes such as molly (*P. sphenops*), guppy (*P. reticulata*), platy (*X. maculatus*) and swordtail (*X. helleri*) using photoperiod [one month (L) and one month (D)] alternately for a period of three months. During this period, effect of photoperiod observed on brooder, in which one month (L) and one month (D) phases were maintained alternately in four different glass aquaria setups named as S_I to S_{IV} , in which molly, guppy, platy and swordtail were kept in ratio of one male and two females respectively to observe their breeding performances such as number of youngones, survival rate percent, mortality rate percent and body colour change. Similarly for next three months, same photoperiod phases were maintained in four different glass aquaria setups named as S_A to S_D to observe effect of photoperiod on growth performance of youngones such as average mean length, average mean weight, specific growth rate percent, percent weight gain percent and colour change. A proper water quality management was done throughout study period and physiochemical parameters such as temperature, pH, dissolved oxygen, nitrite, nitrate, ammonium, phosphate and total hardness were observed and maintained using standard water analysis kits. Feed management was done twice in a day using dried pelleted and dried live frozen feed. Chemical analysis was done after seven days of partial water change to disinfect brooder and their youngones using chemicals such as 'Rid-All-Copper Aid', 'Rid-All-General Aid' and methylene blue. The aim of present study was to find out whether this type of photoperiod phases were playing any role in successful breeding or not, whether helpful in providing healthy crops or not, also whether it going to boost our national income and progress or not. From economic point of view, this type of photoperiod phases should not be applied for breeding of these fishes as from study it was quite clear that their beautiful colour appearance seems to be lost due to change in body colour, which in turn not imparting any benefit to entrepreneurs and women self help group, in order to have a successful living condition and hence overall hampering national income and progress.

Keywords –Breeding performance, Chemical analysis, Feed management, Live bearer ornamental fishes, Photoperiod, Water quality management.

I. INTRODUCTION

The live bearer ornamental fishes belong to family Poeciliidae (Order-Cyprinodontiformes) includes guppies, mollies, platies and swordtails, ovo-viviparous which retain eggs inside the body and give birth to live, free swimming young[1]. The concept of entrepreneurship development through ornamental fish farming is gaining popularity[2]. India has recorded at least 150 commercially important ornamental fish species and trade mainly indigenous freshwater species collected from rivers[3]. Recently it is found that Andhra Pradesh, Odisha, Kerala, Assam, Bihar and other states started producing ornamental fishes[4]. It is found that global exports of ornamental fishes since 2000 rose steadily, from US\$177.7 million to a peak of US\$ 364.9 million in 2011, then declining slightly to US\$347.5 million in 2014[5]. According to NABARD, overall, domestic trade in ornamental fish production cross Rs.1000 lakhs and is growing at the rate of 20% per annum[6]. It is found that photoperiodism influences body colouration and gonadal activity in several fish species[7]. It is found that photoperiod, an important environmental factor which directly or indirectly influences fish growth, feeding, locomotor activity, metabolic rates, body pigmentation, maturation and reproduction[8].

The aim of present study was to find out effect of photoperiod [one month (L) and one month (D)] on breeding performance of brooder and on growth performance of youngones. Also to create general awareness among research scholars, unemployed youth and women self help groups not to practice this type of photoperiod phases during breeding of live bearer ornamental fishes, as they are known for their beautiful colouration which seems to be hamper and which not going to assist their livelihood, as well not going to play any role in national income and progress.

II. MATERIALS AND METHODS

The materials and methods applied during study period were as:

- A. Experimental aquaria :-** A total eight glass aquaria were taken with measurement 8"x6"x10" with 5l water holding capacity.
- B. Light source:-** The photoperiod one month light (natural sunlight) and one month dark (black cardboard covering) were used as source of light.
- C. Candidate species:-** The live bearer ornamental fishes such as black molly (*P.sphenops*), guppy (*P.reticulata*), platy (*X. maculatus*) and swordtail (*X. helleri*) were procured from near by aquarium shops and brought to M.Sc. Fish & Fisheries Research Lab at Baba Saheb Bhim Rao Ambedkar Bihar University, Muzaffarpur, Bihar.
- D. Ratio:-** In each setups I to IV, one male and two females were taken.
- E. Acclimatization:-** The live bearer ornamental fish species were acclimatized in tap water for one week and fed with dried pelleted and dried live frozen feed.
- F. Chemical analysis:-** Chemicals such as "Rid-All -Copper-Aid", "Rid-All-General-Aid", methylene blue and a pinch of salt were used in appropriate amount to disinfect fishes from diseases throughout study period as shown in Figure- 1



Figure- 1 Chemicals used to disinfect fishes

- G. Feed management:-** The dried pelleted and dried live frozen feed were given twice in a day as shown in Fig.2(a) and Figure -2 (b)



Figure-2(a) Dried Pelleted Feed



Figure-2(b) Dried Live Frozen feed

- H. Water quality management:-** Using standard water analysis kits, physiochemical parameters were observed and recorded as mentioned in Table-1

Table-1 Water Quality Management during study period

Parameters	Range	
	One month light	One month dark
Temperature	25-32°C	20-30°C
pH	8	8
Dissolved oxygen	4-7 mg/l	4-9 mg/l
Nitrite	1-2 ppm	0.5-3ppm
Nitrate	0.0-10 ppm	0.0-20 ppm
Ammonium	0-0.5 ppm	0-0.5ppm
Phosphate	1-2 ppm	1-3 ppm
Total hardness	230-290 ppm	260-350 m

I. Experimental design:- During first –three months period, photoperiod(one month light and one month dark) were maintained alternately, in four different glass aquaria setups labeled as S_I to S_{IV} and in each live bearer ornamental fishes molly, guppy, platy and swordtail were kept in ratio of one male and two females respectively, these setups were filled up with 5l tap water and aeration provided to each setups through aerator which was fixed on wooden table with electric supply. The four traps were used in each glass aquaria in order to protect the newly bred youngones from fed by mother fish. During this period breeding performance of live bearer ornamental fishes were observed.

While during next, three months period, newly bred youngones of each live bearer fish were transferred carefully using hand scoop net to four glass aquaria setups, labelled as S_A to S_D . In these setups, photoperiod(one month light and one month dark) were maintained alternately similar to previous three months period. Each setup were filled up with 5l tap water and aeration provided to each one through aerator. During this period, growth performance of youngones were observed.

J. Breeding and Growth Performance:- During study period the length and weight of each brooder were carefully examined before starting of the experiment. Length were measured from tip of snout to the end of caudal fin using divider and finally measured using graduated scale. Weight were weighed and calculated using standard electronic balance. Onwards the average mean length, average mean weight and standard deviation of brooder were calculated using statistical formulas

$$\text{Survival rate (\%)} = \frac{\text{Final no. of fishes}}{\text{Initial no. of fishes}} \times 100$$

$$\text{Mortality rate (\%)} = \frac{\text{Diff. between Initial \& Final no. of fishes}}{\text{Initial no. of fishes}} \times 100$$

$$\text{Specific growth rate (\%)} = \frac{\text{Mean final wt.} - \text{Mean Initial wt.}}{\text{experimental period (T}_2 - \text{T}_1)} \times 100$$

$$\text{Percent weight gain (\%)} = \frac{\text{Mean fish final wt.} - \text{Mean fish Initial wt.}}{\text{Rearing periods (Total period)}} \times 100$$

K. Growth and Body Indices:- From breeding setups, total no. of youngones were counted and note down, then survival rate, mortality rate and colour changes were observed externally and noted down at end of each month. During next three months period, survived youngones were kept in four different setups, S_A to S_D . From each setups randomly molly, guppy, platy and swordtail youngones were taken five in numbers at end of each month. Then their length and weight were measured using graduated scale and electronic balance respectively. This procedure continued for a period of three months. Finally average mean length, average mean weight, standard deviation, survival rate percent, mortality rate percent, specific growth rate percent and percent weight gain were calculated using statics formulas.

Statistical Formulas :

$$\text{Average mean length} = \frac{\text{Sum of the lengths}}{\text{No. of lengths}}$$

$$\text{Average mean weight} = \frac{\text{Sum of the weights}}{\text{No. of weights}}$$

$$\text{Standard deviation } (\sigma) = \sqrt{\frac{1}{N} \sum_{i=1}^N (x_i - \mu)^2}$$

Where σ = Standard deviation

x_i = Each value in data set

μ = Mean of value in data set

$$\frac{1}{N} = \text{No. of observation in data set}$$

III. RESULT

Table – 3.1 Breeding Performance of Brooder during Three Months (one month light and one month dark)

Setups	Live Bearer Ornamental fishes	Length of Brooder		Weight of Brooder		No. of Youngones	Survival rate %	Mortality rate %
		Range	Mean±SD	Range	Mean±SD			
I	<i>P.sphenops</i> (Black molly)	3.8 to 4.0	3.9±0.08	0.76 to 0.86	0.8±0.04	30	83.33	16.66
II	<i>P.reticulata</i> (Guppy)	2.9 to 3.4	3.1±0.22	0.18 to 0.57	0.42±0.17	50	100	Zero
III	<i>X. maculatus</i> (Platy)	3.6 to 3.8	3.7±0.082	0.55 to 0.66	0.62±0.05	40	95	5
IV	<i>X. helleri</i> (Swordtail)	3.2 to 5.0	4.0±0.75	0.40 to 0.89	0.68±0.21	50	100	Zero

Table –3.2 Breeding Performance of Brooder during study period

Setups	Fish species	Commencement of breeding/week
I	Black molly	2 nd month(L), eighth week
II	Guppy	3 rd month(D), ninth week
III	Platy	3 rd month(D), ninth week
IV	Swordtail	3 rd month(D), ninth week

Table – 3.3 Growth Performance of youngones during study period (3 months duration)

		Period							
Setups	Youngones	1 st month		2 nd months		3 rd months		SGR %	PWG %
		Avg.len	Avg.wt.	Avg.len	Avg.wt.	Avg. len	Avg.wt.		
A	Black molly	1.52±0.1	0.07±0.012	1.8 ±0.06	0.108±0.012	2.3±0.08	0.008±0.04	-0.103	-0.07
B	Guppy	1.22±0.08	0.012±0.008	1.8± 0.15	0.05±0.009	2.5±0.11	0.21±0.015	0.33	0.22
C	Platy	1.4±0.08	0.05±0.02	1.7±0.06	0.08±0.008	2.32±0.08	0.19±0.018	0.233	0.16
D	Swordtail	1.5±0.08	0.05±0.00	1.6±0.13	0.06±0.008	2.4±0.08	0.22±0.03	0.283	0.19

Table -3.4 Colour Change observed on Brooder during study period (three months duration)

Setups	Species	Colour changes		
		1 st month	2 nd months	3 rd months
I	Black molly	After 20 days, a little colour change found on fins and on body region	No reappearance	A little more colour change
II	Guppy	After 20days, colour was about to disappear completely	No reappearance	Colourless
III	Platy	After 20 days, only on half portion of body colour change found	No reappearance	About to disappeared
IV	Swordtail	After 20days, colour found to fade but not completely	No reappearance	With dull appearance

Table – 3.5 Colour change observed on bred youngones during study period

Setups	Youngones	Colour change
A	Black molly	A little colour change found on fins and on body region
B	Guppy	Colourless but some colour found on caudal fin region
C	Platy	Colourless
D	Swordtail	With dull appearance



Figure- 3(a) Black molly



Figure- 3(b) Guppy



Figure -3(c) Platy



Figure- 3(d) Swordtail

Figure- 3(a-d) Shows colour changes on yougones during study period

IV. DISCUSSION

Ornamental fishes are natures wonderful creation ,its keeping is the second most preferred hobby in the world, the number of hobbyists for ornamental fish keeping is rising day by day because it provides a great opportunity for entrepreneurship development and income generation[9]. Colour is one of the major factors,which determines the price of aquarium fishes in the world market[10].

During study period of six months duration(one month light and one month dark) were maintained alternately to observed breeding performance of brooder and growth performance of their youngones respectively (each 3 months).During first three months duration, it is found that both light and dark phases favors breeding performance of brooder. It is observed that in setup-I ,commencement of breeding takes place in eight week (second month, light phase),number of youngones found to be 30; in setups-II and III , commencement of breeding takes place in ninth week (third month, dark phase) ,youngones found to be 50 and 40 in numbers; while in setups-IV, commencement of breeding takes place in ninth week(third month, dark phase) and youngones found to be 50 in numbers as shown in Table- 3.1 and Table- 3.2.Youngones survival rate percent found to be more than 83% in all setups-I to IV, where as mortality rate percent found maximum in setup-I(16.66%) and minimum in setups-II and IV(Zero) as shown in Table-3.1.

The above study justified by works of Milton and Arthington (1983), they did work on embryonic development of live bearer fishes and found that embryonic development vary from 26 to 63 days, also demonstrated that temperature is the major factor in the rate of development while photoperiod plays a minor role, as during study period commencement of breeding mostly took place in dark phase.

Colour change on brooder found to be followed a systematic way which observed externally, during first- three months duration, such as in first month(D) phase, in setup-I, after 20 days, a little colour change found on fins and on body region; in setups-II, after 20 days , body colour disappeared completely; in setups-III, after 20 days colour change found only on half portion of body(such as from mouth to dorsal fin region); while in setups-IV,after 20 days, colour found to fade but not completely; while in second months (L) phase, no further reappearance of colour found in all setups-I to IV; while during third months, in setup-I, a little more colour change found; while in setups-II, body colour became transparent ,in setups-III, body colour was about to disappear completely; in setups-IV,with dull appearance. Hence overall during three months duration, in dark phases colour change on brooder observed a different pattern and which in light phase remains constant as shown in Table- 3.4.

The above study not justified by works of Solomon and Okomodo (2012), they observed effect of photoperiod on some biological parameters of *Clarias gariepinus* juveniles for six weeks, found that fishes subjected to photoperiod (24D:00L) exhibited deep shiny black body colouration and 6.67% with normal colouration, while when subjected to

photoperiod(0D:24L) , 80% found to be lighter ,18.46% with normal skin and 1.53% with deep body colouration. But during study period it was not found so as mostly body colour change always proceed in dark phases.

During next three months duration , photoperiod [one month light and one month dark] were maintained alternately to observed growth performance of youngones. During first month, average length of youngones found to be more or less similar in all setups- A, C and D which were as 1.52 ± 0.1 , 1.4 ± 0.08 and 1.5 ± 0.08 respectively, in setup-B, it found to be 1.22 ± 0.08 ,while average weight found to be 0.07 ± 0.012 , 0.012 ± 0.008 , 0.05 ± 0.02 and 0.05 ± 0.008 in all setups-A to D respectively ;during second months, average length showed an increasement from first month in all setups-A to D , which were found as 1.8 ± 0.06 , 1.8 ± 0.15 , 1.7 ± 0.06 and 1.6 ± 0.13 respectively, while average weight also showed an increasement from first month, which were found as 0.108 ± 0.012 , 0.05 ± 0.009 , 0.08 ± 0.008 and 0.06 ± 0.008 in all setups-A to D respectively; while during third months, in setups-A and C, average length found to be similar as 2.3 ± 0.08 and 2.32 ± 0.08 ,which in setups-B and D found with a little difference as 2.5 ± 0.11 and 2.4 ± 0.08 , while average weight found to be 0.0081 ± 0.004 , 0.21 ± 0.015 , 0.19 ± 0.018 and 0.22 ± 0.03 in all setups- A to D respectively.

The above study justified by works of Mustapha *et .al*,(2012) ,they did work on sixty juveniles of the African catfish, *Clarias gariepinus* (Burchell),applying effects of three different photoperiods on the growth and body colouration and found that significant increase occurred in body weight and specific growth rate, those cultured under (24D:00L), followed by (24L:00D) and least under 12D:12L.

During study period , maximum specific growth rate percent found in setup-D (0.2833) and minimum found in setup-A (-0.1033), whereas on otherhand percent weight gain percent found maximum in setups-B (0.22) and minimum found in setup-A (-0.0688) as mentioned in Table- 3.3. The effect of photoperiod in terms of colour change observed on bred youngones during study period and found maximum in setup- C (Platy-colourless) and minimum in setup-A (Black molly-a little) as mentioned in Table-3.5 and Figure- 3(a-d).

V. CONCLUSION

It is concluded that both one month(L) and one month(D) phases play a significant role in successful growth , survival and breeding of these fishes.It is also concluded that in (D) phases ,after 20 days onwards these fishes in each setups showed colour change on body such as in some a little, in some only at half portion ,while in some completely in increasing sequence and its impact directly found on bred youngones during birth. From economic point of view such photoperiod phases should not be applied in ornamental fish industry during breeding procedure as their colour became dull and disappeared completely gradually as time passes on and hence, overall their market value be low, which inturn not going to give any profit to industry as well not impart any role in national income and progress.

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