Scientific Journal of Impact Factor (SJIF): 5.71

e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 5, Issue 03, March -2018

Effect of Photoperiod (15 days light and 15 days 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 black molly (P. sphenops), guppy (P. reticulata) , Platy (X. maculatus) and Swordtail (X. helleri) using photoperiod (15 days (L) and 15 days (D)) phases alternately in a month and hence continued for a period of eight months. During first four months, effect of photoperiod observed on brooder in which 15 days (L) and 15 days (D) phases were maintained in four different glass aquaria setups named as S_I to S_{IV}. Molly, guppy, platy and swordtail were kept in ratio of one male and two females in four different glass aquaria setups, S_I to S_{IV} respectively to observed their breeding performance such as number of youngones, survival rate percent, mortality rate percent and colour changes. Same photoperiod phases were maintained for next four months periods in four different glass aquaria setups named as S_A to S_D to observed effect of photoperiod on growth performance of youngones such as average length, average weight, specific growth rate percent, percent weight gain percent and colour changes. A proper water quality management were done throughout study period and physico-chemical parameters such as temperature, dissolved oxygen, pH, nitrite, nitrate, ammonium, phosphate and total hardness were observed and maintained using standard water analysis kits. Feed management were done using dried pelleted and dried live frozen feed. Chemical analysis were done to disinfect brooder and their youngones throughout study period using easily available chemicals from aquarium shops such as 'Rid - All – Copper Aid' , 'Rid- All – General Aid' and methylene blue. The aim of present study was to found out whether this type of photoperiod 15 days (L) and 15 days(D) phases were appropriate and successful for breeding or not; whether helpful in providing healthy crops or not and whether going to boost our national income or not . From study it was quiet cleared that this photoperiod phases should not be applied for breeding of the live bearer ornamental fishes. As mostly body colour faced changes during dark phases, which created dullness and their beautiful appearance seemed to be lost which inturn brought total economic loss.*

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

I. INTRODUCTION

Ornamental fishes are referred as "Living jewels" due to their beautiful colors, shapes, sizes, behavior and so on. [1] Ornamental fish culture practicing is an excellent business, which have large opportunity in India since there is strong demand from both domestic and export market. [2] India's overall ornamental fish trade was about 1.06 million US $ during year 2009. [3] Indian ornamental fishes are exported to Singapore, US, UK, Belgium, Italy, Japan, China, Australia and South Africa. [4] Ornamental fishes have a good potential due to enormous geographical spread, extensive species diversity and intensive research and development effort that are already put in by the associated institutions. [5] FAO data suggest that ornamental fish exports were worth approximately $ 330 million USD in 2011, the number of fish traded estimated at approximately 1.5 billion fish per annum. [6] Fish are able to visually discriminate colours although species specific sensitivities exist probably as a result to adaptation of the visual and non – visual system to specific natural habitats. Light of different spectral composition can affect fish growth and survival, body pigmentation, stress response and reproduction. Light is a key environmental factor that synchronizes all stages of fish from embryo development to sexual maturation. [7] The colouration in fish is liable and which can be manipulated at the individual level both by morphological [8] and physiological colour change.[9] The sexual selection acts on colour and patterns leading colourful displays and also more diverse colouration pattern.[10]

The aim of present study is to create general awareness among research scholars, unemployed youth and women self help groups not to practiced these type of photoperiod phases during breeding procedures of live bearer ornamental fishes, as it provides economic loss, no benefit for their livelihood as well ,also not going to impart any role in national income.

II. MATERIALS AND METHODS

The materials and methods which applied during study period were as :

A. **Experimental aquaria** :- A total eight glass aquaria were taken with measurement 8" x 6" x10" with 5 L water holding capacity.
B. **Light source** :- The photoperiod, 15 days light(natural sunlight) and 15 days 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 set ups 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. **Water quality management** :- The water quality management were done using standard water analysis kits and

physiochemical parameters were observed and recorded as mentioned in Table-1.

Table – 1 Water Quality Management during Study Period

Parameters	Range	
	15 days light phase	15 days dark phase
Temperature	25-32ºC	20-30ºC
pH	7.5 – 8	8
Dissolved Oxygen	5-7 mg/l	6-8 mg/l
Nitrite	1-5 p.p.m	0.5 – 1 p.p.m
Ammonium	0-0.05 p.p.m	0.05 – 1 p.p.m
Phosphate	1-2 p.p.m	1-3 p.p.m
Total hardness	220 – 320 p.p.m	250-350 p.p.m

G. **Feed management** :- The dried pelleted and dried live frozen feed were given twice in a day as mentioned in Figure- 1(a) and Figure-1(b)

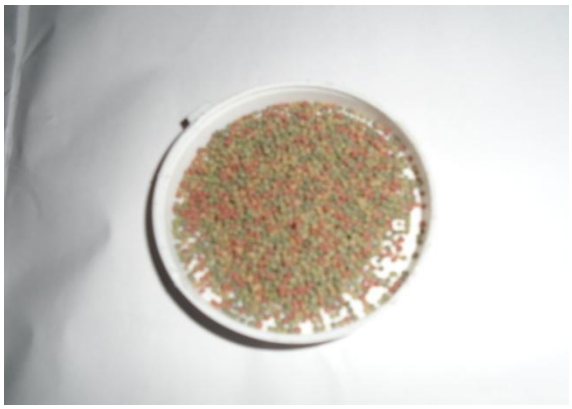

Figure -1(a) Dried Pelleted Feed

Figure -1(b) Dried Live Frozen Feed

H. **Chemical analysis** :- The different chemicals such as "Rid –All-Copper-Aid " ,"Rid –All-General-Aid", "Methylene blue" and a pinch of salt were used in appropriate amount to prevent fishes from diseases throughout study period as mentioned in Table-2

Table – 2 Chemicals Used for Prevention of Diseases

Chemicals	Method and Dose	Purpose
Methylene Blue	2ml in 5 litres of aquarium water added per week with partial water change	For purification of water
Salt	1 small teaspoon with chemicals added per week with partial water change	Act as disinfectant
Rid – All -General Aid	2 ml in 5 litres of aquarium water added per week with partial water change	Act as bactericide and fungicide
Rid- All – Copper Aid	2ml in 5 litres of aquarium water added/ week with partial water change	Prevention from skin, gill protection and fluke infection

I. **Experimental design** :- During first –four months period, photoperiod (15 days light and 15 days dark) were maintained alternately, in four different glass aquaria setups labelled 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 inorder 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 , four 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 (15 days light and 15 days dark) were maintained alternately similar to previous four –months period. Each setups 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.

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

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

$$\text{Specific growth rate (\%)} = \frac{Mean\ final\ Wt.-Mean\ Initial\ Wt.}{experimental\ \ period\ \ (T_2 - T_1)} \times 100$$

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

K. **Growth and Body Indices** :- From breeding setups ,total number of youngones were counted and noted down ,then survival rate , mortality rate and colour changes were observed externally and noted down at end of each month .During second , four 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 four 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 :

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

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

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

Where

	σ	=	Standard deviation
	x_i	=	Each value in data set
	μ	=	Mean of value in data set
	$\frac{1}{N}$	=	No. of observation in data set

III. RESULT

Table – 3.1 Breeding Performance of Brooder during Four Months (15 days light and 15 days days dark) Duration

Set ups	Live Bearer Ornamental Fish species	Length of Brooder		Wt. of Brooder		No. of Young ones	Survival rate %	Mortality rate %
		Range	Mean ± SD	Range	Mean ± SD			
I	*P. sphenops* (Black Molly)	3.3 to 4.0	3.6 ± 0.29	0.56 to 0.70	0.62 ± 0.06	40	87.5	12.5
II	*P. reticulata* (Guppy)	2.7 to 3.9	3.3 ± 0.49	0.23 to 0.59	0.47 ± 0.17	30	86.66	13.33
III	*X. maculatus* (Platy)	4.5 to 4.8	4.6 ± 0.13	0.79 to 1.20	0.9 ± 0.19	20	90	10
IV	*X. helleri* (Swordtail)	3.5 to 4.0	3.8 ± 0.24	0.55 to 1.03	0.86 ± 0.22	40	100	Zero

Table – 3.2 Breeding Performance during study period

Setups	Fish Species	Comment of Breeding/week (15 days light and 15 days dark)
I	*P. sphenops* (Black Molly)	Starting of ninth week (3^{rd} month, 15 days light)
II	*P. reticulata* (Guppy)	End of ninth week (3^{rd} month, 15 days light)
III	*X. maculatus* (Platy)	Starting of ninth week (3^{rd} month, 15 days light)
IV	*X. helleri* (Swordtail)	End of eight Week (2^{nd} month, 15 days dark)

Table – 3.3 Growth Performance of Youngones during Four Months duration [15 days light and 15 days Dark]

Set ups	Young ones	Period								Specific growth rate %	Percent wet gain%
		Ist month		2nd month		3rd months		4th months			
		Avg. length	Avg. wt.	Avg. length	Avg. wt.	Avg. length	Avg. wt.	Avg. length	Avg. wt.		
A	Black molly	1.46 ± 0.10	0.06 ± 0.009	1.9 ± 0.08	0.16 ± 0.014	2.4 ± 0.10	0.20 ± 0.04	2.6 ± 0.077	0.25 ± 0.028	0.2111	0.15833
B	Guppy	1.4 ± 0.13	0.016 ± 0.013	2.14 ± 0.01	0.15 ± 0.011	2.6 ± 0.10	0.24 ± 0.04	2.5 ± 0.109	0.24 ± 0.024	0.2488	0.1866
C	Platy	1.4 ± 0.09	0.0.5 ± 0.008	2.1 ± 0.14	0.16 ± 0.03	2.8 ± 0.10	0.24 ± 0.02	2.9 ± 0.109	0.40 ± 0.028	0.388	0.2916
D	Sword tail	1.4 ± 0.13	0.04 ± 0.021	1.7 ± 0.118	0.07 ± 0.013	2.5 ± 0.19	0.24 ± 0.07	2.8 ± 0.14	0.35 ± 0.068	0.3444	0.25833

Table – 3.4 Colour change observed on Brooder during Breeding Performance [15 days light and 15 days Dark] Phase

Setups	Young ones	Period							
		Ist month		2nd months		3rd months		4th months	
		15 d (L)	15 d (D)	15 d (L)	15 d (D)	15 d (L)	15 d (D)	15 d (L)	15 d (D)
A	Black molly	No	A little bit	No further reappearance	A little more	No further reappearance	More found on fins and on body region	No further reappearance	No further Change
B	Guppy	No	A little bit	No further reappearance	About to disappear	No further reappearance	Transparent	No further reappearance	No further Change
C	Platy	No	A little bit	No further reappearance	A little more	No further reappearance	More found on fins and on body region	No further reappearance	About to disappear
D	Sword tail	No	A little bit	No further reappearance	About to disappear	No further reappearance	Transparent	No further reappearance	No further change

Table – 3.5 Colour Change Observed on bred young ones during fourth month duration

Setups	**Youngones of fish species**	**Colour change**
A	Black molly	A little change found on fins and on body region.
B	Guppy	Transparent
C	Platy	About to disappear
D	Swordtail	Transparent

IV. DISCUSSION

The live bearer ornamental fishes found in different color, forms and sizes. There are four major species of these fishes Which are known as molly, guppy, platy and swordtail. During study period of eight months duration ,photoperiod[15days(L) and 15 days(D)] were maintained alternately to observed breeding performance of brooder and youngones respectively (each 4 months duration).

During first-four months duration, it is found that both light and dark phases favors breeding performance. It is observed that in setups-I and II commencement of breeding takes place in ninth week and number of youngones found to be 40 and 30 in number while in setups-III and IV ,takes in tenth and eleventh week and found to be 20 and 40 in number, as shown in Table -3.2. Youngones survival rate found to be more than 85% in all setups-I to IV, maximum in setups-IV(100%) and minimum in setups-II(86.66%) as shown in Table -3.1.The above study not justified by works of Santhanam et al.(2013),as they observed that commencement of breeding takes place after four weeks but during study it is found in eight weeks and after eight weeks of fertilization,but on otherhand next observation justified by their works that fecundity rate is 20-40 youngones per female in an average. During study period, survival percentage found to be more than 85 in all setups and which is not affected by 15 days light and 15 days dark phases, which is not justified by works of Opiyo (2010) ,did work to observed influence of stocking density and background colour on the growth performance and survival of Nile Tilapia fry(*Oreochromis niloticus)* and found that growth performance is lowest in black background.

Colour change on brooder found to be followed a systematic way which observed externally, during first-four months duration as :during first month [15 days (L) phase],no colour change found while in [15days (D)phase] ,a little bit colour change observed in all setups-I to IV; during second month, in [15 days(L)phase],no further reappearance found while in [15days(D)phase],a little more colour change found in setups-I and III, on otherhand in setups-II and IV, about to disappear completely; during third month, in [15days(L)phase],no further reappearance found in all setups-I to IV ,while during [15days(D)phase] in setups-I and III, more colour change found on fins and on body region while in setups-II and IV,body colour became transparent; finally during fourth month, in [15days(L)phase], no further reappearance found in all setups-I to IV, while in [15days(D)phase], no further colour change found in setups-I,II and IV but on otherhand in setups-III, colour was about to disappear completely. Hence,overall during four months duration ,colour change on brooder occured in increasing sequence, which in dark phase observed progressively but on otherhand in light phase, it remains constant as shown in Table-3.4 .The above study not justified by works of Jauro and Usman(2015), they observed the effect of photoperiod on the growth of African catfish and found that those fishes subjected to(00L:24D)were darker and black in appearance than those to(06L:18D) had a lighter grey appearance and those subjected to(12L:12D)had a normal dark grey colouration.

During second-four months duration, photoperiod[15days(L) and 15days(D)] were maintained alternately and this process

Continued for four months duration to observed growth performance of youngones. During first month ,average length of youngones found to be more or similar in all setups-A to D, which were as 1.46±0.10,1.4±0.13, 1.4±0.09 and 1.4±0.13 respectively, while average weight found with little differences which were as 0.06±0.009,0.016±0.013,0.05±0.008 and 0.04±0.021 respectively; during second months, average length showed an increasement from first month in all setups-A to D ,which was found as1.9±0.08,2.14±0.01,2.1±0.14 and 1.7±0.118 respectively, while average weight showed an increasement from first month which were as 0.16±0.014(setup-A), 0.15±0.01(setups-B),0.16±0.03(setups –C) and 0.07±0.013(setups-D); during third months, an increasement also found in average length which were as 2.4±0.10(setup-A),2.6±0.10(setups-B) , 2.8±0.10(setups-C) and 2.5±0.19(setups-D), while average weight also showed an increasement from previous month and found to be similar as 0.24±0.04(setups-B),0.24±0.02(setups-C) and 0.24±0.07(setups-D) respectively, while a decreasement as 0.20±0.04(setup-A) ;during fourth month, average length showed an increasement from previous months which were as 2.6±0.077(setup-A),2.9±0.109(setups-C),2.8±0.14(setups-D), while a decreasement found in setups-B, as 2.5±0.109, while in average

weight increasement found from previous months as 0.25±0.028(setup-A), 0.40±0.028(setups-C),0.35±0.068(setups-D),while in setups-B ,no increasement found from previous months which was 0.24±0.024.

During study period, maximum specific growth rate percent found in setups-C, (0.388)and minimum found in setup-A, (0.2111), on other hand percent wet gain percent found maximum in setups-C(0.2916) and minimum in setup-A(0.15833) as mentioned in Table -3.3.The above study justified by works of Rajeswari, Rajasree and Balasubramanian(2017),they observed effect of light levels on growth ,survival and skin colour enhancement of marine angelfish(*A.xanthurus)* and found that low light level(250-500 lux) was more suitable for better growth.It is also supported by work of Jauro and Usman(2015) as they found significant increase in body weight and specific growth rate when fishes subjected to (00L:24D).
The effect of photoperiod observed on bred youngones and colour change found maximum in setups-B (Guppy-transparent) and in setups-D(Swordtail-transparent) then in setups-C (Platy-colour about to disappear) and minimum in setup-A(Black molly-a little color change) as mentioned in Table- 3.5

V. CONCLUSION

It is concluded that both 15 days [L] and 15 days [D] phases play a significant role in successful growth, survival and breeding of these fishes. It is also concluded that during dark phase, body color of brooder starts changing in increasing order and produced youngones have to face these colour changes on their body automatically from birth. From economic point of view, this breeding procedures should not be followed for breeding purpose of these fishes as it provides total economic loss and no profit .

VI. ACKNOWLEDGEMENT

Authors wish to express gratitude to DST, New Delhi, for providing financial assistance during study period. I would like to give my special thanks to M.Sc. Fish & Fisheries Course under aegis of Zoology Department at Baba Saheb Bhim Rao Ambedkar Bihar University, Muzaffarpur, Bihar and CIFRI Centre, Saltlake, Kolkata, for helping and providing lab facilities during study period.

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