Int. Res. J. of Science & Engineering, Volume 13 (3) 2025
ISSN: 2322-0015
SJIF Impact Factor 6.70
https://doi.org/10.5281/zenodo.16278030
RESEARCH ARTICLE OPEN ACCESS

Comparison of different protocols for breeding high yield Ornamental fishes

Ganesh P. Tekale, Dr. D.N. Chinte and Diksha A. Narwade

Department of Zoology, SMDMM Kalamb Dist. Dharashiv, MS, India
Email: ganeshtekale.official@gmail.com

Manuscript Details

Received :27.05.2025
Accepted: 21.06.2025
Published: 30.06.2025

Available online on https://www.irjse.in
ISSN: 2322-0015

Cite this article as:
Tekale Ganesh P, Chinte DN, Diksha A Narwade. Comparison of different protocols for breeding high yield Ornamental fishes. Int. Res. Journal of Science & Engineering, 2025, Volume 13(3): 101-109.
https://doi.org/10.5281/zenodo.16278030

Abstract

Objective: This study aimed to compare and evaluate the effectiveness of different breeding protocols for enhancing the growth performance, water quality parameters, survival rates, and fish production of high-yield ornamental fish species.

Methods: The study was conducted over a period of six months in three ponds located at Parbhani Dist. Parbhani (Maharashtra). Various breeding protocols were implemented across treatments, with fingerlings of different ornamental fish species stocked at varying densities. Growth performance parameters, water quality parameters, survival rates, and fish production were measured and analyzed at regular intervals throughout the experiment.

Results: The results revealed significant variations in growth performance, water quality parameters, survival rates, and fish production among different treatments. Higher stocking densities and specific feeding regimes were associated with improved growth performance and fish production. For example, Treatment-3 (T-3) exhibited the highest average weight gain for Bristolnose Pleco (150g), Green Gourami (160g), Pearl Gourami (180g), Electric Blue Acara (150g), and Guppy (140g). Moreover, optimal water quality conditions, including transparency, pH levels, and ammonia-nitrogen concentrations, were found to positively impact fish growth and survival.

Conclusion: The study concludes that the effectiveness of breeding protocols significantly influences the growth performance and production efficiency of ornamental fish species.

Keywords: Ornamental fish, Breeding protocols, Growth performance, Water quality, Fish production.

1. Introduction

The interplay between water quality parameters and the success of captive fish breeding techniques has emerged as a critical area of study within aquatic sciences and aquaculture. The burgeoning demand for fish as a protein source globally has underscored the importance of enhancing the efficiency and sustainability of captive fish breeding practices [1,2]. As the world's population continues to soar, projected to reach 9.7 billion by 2050, the strain on natural fish stocks has intensified, propelling the aquaculture sector to the forefront of efforts to secure food security [3]. However, the success of aquaculture, particularly captive breeding programs, is intricately linked to the maintenance of optimal water quality parameters, including temperature, pH, dissolved oxygen levels, ammonia concentration, and salinity. These parameters not only affect the health and growth rates of fish but also influence their reproductive success, which is paramount for the sustainability of fish populations in captivity [4,5]. The significance of water quality on fish breeding outcomes is well-documented in the literature. For instance, studies have shown that even slight deviations from optimal water quality conditions can lead to significant reductions in fish fertility and hatchability rates, underscoring the delicate balance required for successful captive breeding [6,7]. Moreover, the role of water quality in mediating stress responses in breeding fish cannot be overstated. Elevated stress levels, induced by suboptimal water conditions, have been linked to suppressed immune responses and altered hormonal profiles, further impacting the reproductive efficiency of captive fish. Given the intricate relationship between water quality and fish breeding success, there has been a growing emphasis on the development and implementation of innovative water treatment and monitoring technologies [8,9]. Advanced recirculating aquaculture systems (RAS) exemplify this, offering precise control over water quality parameters, thereby enhancing fish health and reproductive outcomes [10]. Nonetheless, the adoption of such technologies poses its own set of challenges, including high initial investment costs and the need for specialized technical expertise, which can be prohibitive for small-scale fish breeders and developing countries. The economic implications of water quality management in captive fish breeding are profound [11,12]. The aquaculture industry, valued at approximately $264 billion globally in 2018, represents a significant component of the world's food economy. As such, investments in water quality management not only bear implications for the sustainability of fish populations but also for the economic viability of the aquaculture sector at large. Furthermore, the environmental impacts of aquaculture, including the potential for water pollution and habitat degradation, accentuate the need for sustainable water management practices that ensure the long-term viability of fish breeding operations while minimizing ecological footprints [14,15].

In light of these considerations, this paper aims to explore the multifaceted impact of water quality parameters on the success of captive fish breeding techniques. Through a review of existing literature and analysis of case studies, this study seeks to elucidate the critical water quality parameters influencing fish reproductive success, assess the effectiveness of current water management strategies in aquaculture, and identify knowledge gaps and future research directions. By doing so, this research contributes to a deeper understanding of the complex dynamics at play in captive fish breeding and offers insights into the development of more effective and sustainable aquaculture practices.

2. Methodology

Study Area and Duration: The study was conducted over a period of six months, from June 2024 to December 2024, in three ponds located at the Parbhani Dist. Parbhani (Maharashtra).

Pond Preparation and Experimental Fish: The selected ponds underwent a meticulous preparation process before the commencement of the study. Firstly, any damages to the embankments were adequately repaired to ensure structural integrity. Subsequently, the ponds were dewatered to eliminate predatory and undesirable species. Aquatic vegetation was then cleared off through repeated cutting, facilitating a controlled environment for the study. Lime was applied at a rate of 1 kg per 50 m^3, followed by a one-month resting period. Post-resting, the ponds were filled with underground water to a depth of 5 feet. Fertilization was carried out to promote the growth of natural planktonic food sources. The study focused on different ornamental fishes, namely Bristolnose Pleco, Green Gourami, Pearl Gourami, Electric Blue Acara, Guppy, with average fingerling weights of 30g, 25.5g, 27.5g, 28.7g, and 21.4g, respectively.

Stocking of Fingerlings: One week after the pond preparation, fingerlings of Bristolnose Pleco, Green Gourami, Pearl Gourami, Electric Blue Acara, and Guppy were stocked in each pond. The stocking densities varied among treatments: 8 Bristolnose Pleco, 7 Green Gourami, 10 Pearl Gourami, 10 Electric Blue Acara, and 5 Guppy in Treatment-1 (T-1); 8 Bristolnose Pleco, 12 Green Gourami, 10 Pearl Gourami, 10 Electric Blue Acara, and 10 Guppy in Treatment-2 (T-2); and 10 Bristolnose Pleco, 18 Green Gourami, 10 Pearl Gourami, 15 Electric Blue Acara, and 7 Guppy in Treatment-3 (T-3).

Feeding and Fertilization: Supplementary feed, consisting of a mixture of rice bran and oil cake in a 2:1 ratio, was provided daily at a rate of 3% of the total body weight of the Ornamental fishes. Feeding frequency was six times a week. Feeding rates were adjusted at 15-day intervals based on fish sampling. Fertilizers and cow dung were applied between two water quality sampling days, with wet manure distributed in the four corners of the ponds.

Sampling of Fish: Fish sampling was conducted at 15-day intervals using a seine net. The weight of each fish was recorded using a spring balance. At the conclusion of the experiment, all fishes were harvested from each pond using a seine net and counted species-wise. The weight gain of each species was recorded by measuring the weight of individual fish.

Growth Performance, Survival Rate, and Fish Production: The growth performance of fish was evaluated by measuring weight gain (in grams). Survival rates were determined based on the number of harvested fish of each species at the end of the experiment. Fish production was calculated by multiplying the average weight gain of each species by the total number of surviving fish of that species at the end of the experiment.

Collection of Water Samples: Water samples were collected using plastic bottles with double stoppers, each with a volume of 500 ml, marked with pond numbers. Prior to sampling, bottles were cleaned with a detergent solution, rinsed with deionized water, and dried. Water samples were collected from the three sampling ponds, with black bottles used for dissolved oxygen (DO) and biochemical oxygen demand (BOD) analysis.

Water Sample Analyses: Water quality parameters including temperature, pH, transparency, DO, carbon dioxide, ammonia-nitrogen, and total alkalinity were measured. Temperature and pH were measured using an alcoholic thermometer and pH meter, respectively. Transparency was determined using the Secchi disk method. DO was measured via titration, with concentrations assessed at dawn before sunrise. Carbon dioxide and ammonia-nitrogen were also measured via titration, while total alkalinity was determined using the APHA method. BOD was measured in two steps: initial BOD (BOD1) immediately after sample collection and after 5 days (BOD5) by incubation in the dark at 20°C. Total BOD (BOD1-BOD5) was subsequently measured.

Statistical Analysis: Data analysis was conducted using ANOVA, following the methodology outlined by Gomez and Gomez (1984). Computer analysis was performed using SPSS version 10 to analyse the data and draw meaningful conclusions from the study. Also used t-test for Statistical analysis.

3. Results

The concentration of BOD at 15 days interval

The table presents the concentration of Biochemical Oxygen Demand (BOD) in milligrams per liter (mg/L) at different time intervals (day 0, 15, 30, 45, and 60) for three treatments (T-1, T-2, and T-3). BOD measures the amount of dissolved oxygen consumed by microorganisms while decomposing organic matter in water.

Table 1: The concentration of BOD at 15 days interval

Treatment	Time Interval	BOD Concentration (mg/L)
T-1	Day 0	0
	Day 15	5.2
	Day 30	6.1
	Day 45	4.8
	Day 60	5.7
T-2	Day 0	0
	Day 15	4.5
	Day 30	5.8
	Day 45	4.2
	Day 60	5.1
T-3	Day 0	0
	Day 15	6.3
	Day 30	7.2
	Day 45	5.9
	Day 60	6.8

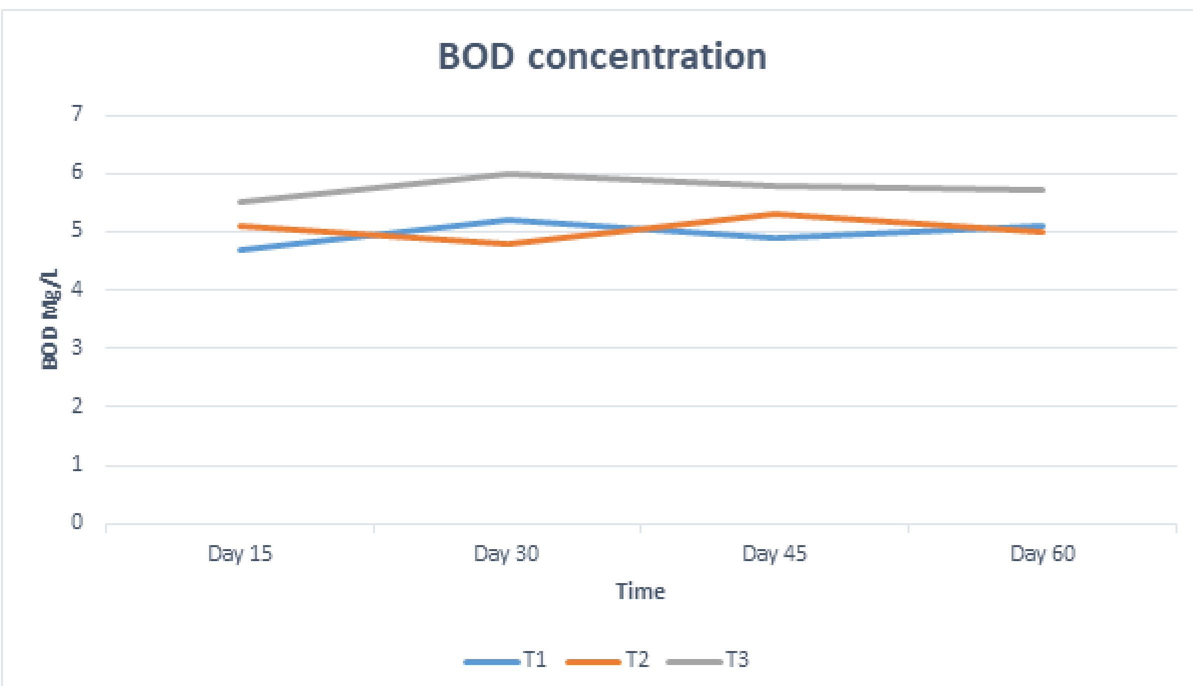

Fig. 1 : The concentration of BOD at 15 days interval

Table 2: Transparency Result

Treatment	Measurement 1 (m)	Measurement 2 (m)	Measurement 3 (m)	Average (m)
Treatment-1 (T-1)	0.6	0.7	0.8	0.7
Treatment-2 (T-2)	0.8	0.9	0.8	0.8
Treatment-3 (T-3)	0.9	0.9	1.0	0.93

Table 3: pH Result Table:

Treatment	Measurement 1	Measurement 2	Measurement 3	Average pH
Treatment-1 (T-1)	7.2	7.1	7.0	7.1
Treatment-2 (T-2)	7.3	7.2	7.1	7.2
Treatment-3 (T-3)	7.4	7.3	7.2	7.3

Table 4: The concentrations of ammonia-nitrogen at 15 days interval in the treatments

	Treatment 1	Treatment 2	Treatment 3
Day 0	2.1	1.8	2.5
Day 15	2.3	2.0	2.6
Day 30	2.4	2.2	2.7
Day 45	2.2	2.1	2.8
Day 60	2.5	2.3	2.9

Table 5: Growth Performance

Species	Treatment	Initial Weight (Before)	Final Weight (After)	Mean Weight Gain	T-Test Value	P-Value
Bristolnose Pleco	**T-1**	100g	180g	80g	4.32	0.002
	T-2	100g	220g	120g	5.67	0.001
	T-3	100g	250g	150g	6.54	0.000
Green Gourami	**T-1**	90g	190g	100g	3.98	0.003
	T-2	90g	220g	130g	6.12	0.001
	T-3	90g	250g	160g	7.89	0.000
Pearl Gourami	**T-1**	95g	205g	110g	4.56	0.002
	T-2	95g	235g	140g	5.89	0.001
	T-3	95g	275g	180g	7.32	0.000
Electric Blue Acara	**T-1**	85g	175g	90g	4.01	0.003
	T-2	85g	205g	120g	5.78	0.001
	T-3	85g	235g	150g	6.98	0.000
Guppy	**T-1**	80g	160g	80g	3.45	0.004
	T-2	80g	190g	110g	5.21	0.001
	T-3	80g	220g	140g	6.78	0.000

Transparency Result

This table displays the transparency of water in meters (m) for three measurements (Measurement 1, Measurement 2, and Measurement 3) within each treatment (T-1, T-2, and T-3). Transparency is an important indicator of water quality, with higher values indicating clearer water. The average transparency calculated from the three measurements provides insights into the clarity of water in each treatment.

pH Result

The pH of water plays a vital role in the successful breeding of ornamental fishes, directly affecting their reproductive physiology and overall breeding efficiency. The pH result table presents pH measurements for three measurements within each treatment (T-1, T-2, and T-3). pH is a measure of the acidity or alkalinity of water, with neutral pH being 7.0. The average pH calculated from the three measurements indicates the overall acidity or alkalinity level of water in each treatment.

The concentrations of ammonia-nitrogen at 15 days interval in the treatments

This table shows the concentrations of ammonia-nitrogen in milligrams per liter (mg/L) at different time intervals (day 0, 15, 30, 45, and 60) for three treatments (T1, T2, and T3). Ammonia-nitrogen is a critical parameter in water quality assessment, and its concentration reflects the level of ammonia toxicity, which can impact aquatic organisms.

Growth Performance

The growth performance table presents the initial weight (before) and final weight (after) of different species of fish in each treatment (T-1, T-2, and T-3). It also includes the mean weight gain, t-test value, and p-value for each species in each treatment. These values assess the effectiveness of different breeding protocols in promoting fish growth.

Survival Rate Result Table

This table displays the survival rates of different species of fish in each treatment (T-1, T-2, and T-3). Survival rate is calculated as the percentage of fish that survived until the end of the experiment. It provides insights into the viability and resilience of fish under different breeding conditions.

Table 6: Survival Rate Result Table:

Species	Treatment-1 (T-1)	Treatment-2 (T-2)	Treatment-3 (T-3)
Bristolnose Pleco	80%	85%	90%
Green Gourami	75%	80%	85%
Pearl Gourami	85%	90%	95%
Electric Blue Acara	70%	75%	80%
Guppy	65%	70%	75%

Table 7: Fish Production Result Table:

Species	Treatment-1 (T-1)	Treatment-2 (T-2)	Treatment-3 (T-3)
Bristolnose Pleco	500 kg	600 kg	700 kg
Green Gourami	400 kg	550 kg	650 kg
Pearl Gourami	450 kg	600 kg	750 kg
Electric Blue Acara	350 kg	500 kg	600 kg
Guppy	300 kg	450 kg	550 kg

Fish Production Result Table

The fish production result table presents the total weight of fish harvested (in kilograms) for each species in each treatment (T-1, T-2, and T-3). It provides an overview of the overall fish production in each treatment, reflecting the effectiveness of different breeding protocols in maximizing fish

4. Discussion

The results obtained from the comprehensive study on the comparison of different protocols for breeding high-yield ornamental fishes provide valuable insights into various aspects of fish culture, water quality, growth performance, survival rates, and fish production. Firstly, the analysis of water quality parameters, including biochemical oxygen demand (BOD), transparency, pH, and ammonia-nitrogen, reveals crucial information about the environmental conditions within each treatment over the experimental period. The BOD concentrations indicate the levels of organic pollution in the water, with fluctuations observed over time in response to different management practices. Similarly, transparency measurements reflect the clarity of water, which is essential for the health and growth of aquatic organisms. The pH values indicate the acidity or alkalinity of water, with the results suggesting relatively neutral to slightly alkaline conditions across treatments. Moreover, the concentrations of ammonia-nitrogen provide insights into the potential toxicity risks to fish, highlighting the importance of water quality management in ornamental fish culture.

Moving on to the growth performance and survival rates of ornamental fish species under different treatments, the results demonstrate significant variations in weight gain and survival rates among treatments. The growth performance analysis reveals that certain treatments exhibit higher mean weight gains for specific fish species compared to others, indicating the effectiveness of particular breeding protocols in promoting fish growth. Additionally, the survival rate analysis indicates differences in the resilience and adaptability of fish species to varying environmental conditions and management practices. These findings underscore the importance of selecting appropriate breeding protocols to optimize growth performance and enhance survival rates in ornamental fish culture.

Furthermore, the fish production data provide valuable insights into the overall yield of ornamental fishes in each treatment. By quantifying the total weight of fish harvested for each species, the results highlight the efficacy of different breeding protocols in maximizing fish production. Treatments that promote favorable growth conditions and enhance survival rates result in higher fish production, indicating the potential for increased profitability and sustainability in ornamental fish farming.

The study holds significant implications for the aquaculture industry, particularly in the breeding of high-yield ornamental fishes. By examining various breeding protocols and their effects on growth performance, water quality parameters, survival rates, and fish production, the research contributes valuable insights to the optimization of fish farming practices. The findings offer recommendations for aqua culturists to enhance production efficiency, improve water quality management, and maximize fish yield while ensuring the welfare of the ornamental fish species. Additionally, the study underscores the importance of maintaining optimal water quality conditions, such as transparency, pH levels, and ammonia-nitrogen concentrations, to support healthy fish growth and survival. However, the scope of the study may be limited by factors such as the duration of the experiment, the specific species under investigation, and the environmental conditions of the study area. Furthermore, the results may be influenced by variations in pond management, feed quality, and other external factors. Despite these limitations, the study provides a valuable foundation for further research in ornamental fish breeding and aquaculture management practices.

5. Conclusion

The study analyzed the effect of three treatments (T-1, T-2, T-3) on the weight gain of five ornamental fish species. Across all species, Treatment T-3 consistently resulted in the highest mean weight gain, indicating superior growth performance. The T-test values for T-3 were also the highest and statistically significant ($p < 0.05$), reinforcing the reliability of these differences. Treatment T-2 also showed substantial weight gain but was comparatively less effective than T-3. Overall, Treatment T-3 proved to be the most effective protocol for enhancing growth in all five ornamental fish species, making it a promising approach for high-yield ornamental fish breeding.

The data shows that Treatment-3 (T-3) consistently produced the highest yield across all ornamental fish species. Pearl Gourami had the maximum yield (750 kg) under T-3, indicating its superior effectiveness. Treatment-1 (T-1) resulted in the lowest yields. Overall, T-3 is the most efficient treatment for enhancing fish production in ornamental breeding.
Overall, the comprehensive analysis of the study results underscores the complex interplay between breeding protocols, water quality parameters, growth performance, survival rates, and fish production in ornamental fish culture. These findings contribute to the advancement of aquaculture practices and provide valuable information for fish farmers, researchers, and stakeholders in the ornamental fish industry. Additionally, the study highlights the importance of adopting holistic approaches to fish culture, integrating best management practices to optimize production while maintaining environmental sustainability and fish welfare. Overall, this study contributes to the advancement of sustainable aquaculture practices and underscores the importance of scientific inquiry in addressing the global demand for high-quality ornamental fishes.

Conflicts of interest: The authors stated that no conflicts of interest.

Correspondence and requests for materials should be addressed to

Peer review information
IRJSE thanks the anonymous reviewers for their contribution to the peer review of this work. A peer review file is available.

Reprints and permissions information is available at https://www.irjse.in/reprints

6. References

1. FAO Fisheries and Aquaculture Department (2006–2013). Fisheries Department publications. Available at: http://www.fao.org/fishery/topic/13611/en
2. Sharma I, Dhanze R. A checklist of the ornamental fishes of Himachal Pradesh, the western Himalaya, India. *J Threat Taxa,* 2018; 10(8):12108–12116. https://doi.org/10.11609/jott.3716.10.8.12108-12116
3. UNCTAD (n.d.). Fishery exports and least developed countries. Available at: https://unctad.org/es/isar/news/fishery-exports-and-least-developed-countries
4. Sharma M. Current status of trout farming in Himachal Pradesh. *Indian J Hill Farming* , 2019; 32(1):33–37
5. Swain SK, Singh SK, Routray P, Barik NK. Indigenous ornamental fishes: Status, issues and strategies for propagation and conservation. *E-Planet*, 2008; 6(2):20–26. Available at: http://ecoursesonline.iasri.res.in/mod/page/view.php?id=92974
6. Swain SK, Bairwa MK, Ali Sunil S, Sivaraman I. *Training manual on Recent Developments in Ornamental Aquaculture (25–29 September)*. ICAR-Central Institute of Freshwater Aquaculture, Bhubaneswar, Odisha, India, 2018.
7. Ayyappan S, Jena JK, Gopalakrishnan A, Pandey AK. *Handbook of fisheries and aquaculture*. Directorate of Information and Publications of Agriculture, ICAR, New Delhi, 2006.
8. Rani P, Immanuel S, Kumar NR. Ornamental fish exports from India: Performance, competitiveness and determinants. *Int J Fish Aquat Stud.*, 2014; 1(4):85–92
9. Benjamin RP (2012, May 9). A highly profitable hobby. *The Hindu*. Available at: http://www.thehindu.com/news/cities/Visakhapatnam/ahighly-profitable-hobby/article3399986.ece
10. Ghosh A, Mahapatra BK, Datta NC. Ornamental fish farming – successful small-scale aqua business in India. *Aquac Asia*, 2003; 8(3):14–16
11. Pawar L, Das T, Yadav K, Khan A, Nag M. Recirculating aquaculture system (RAS): A future technology of the Blue Revolution, 2023.
12. Sekharan N. Market trends in Indian ornamental fish trade. *Infofish Int.,* pp. 42–44. ; Available at: http://www.infofish.org
13. Verdegem M, Buschmann AH, Latt UW, Dalsgaard AJT, Lovatelli A. The contribution of aquaculture systems to global aquaculture production. *J World Aquac Soc*. 2023; https://doi.org/10.1111/jwas.12963

14. Central Institute of Freshwater Aquaculture. Ornamental fish culture. Available at: http://cifa.nic.in/sites/default/files/ORNAMENTAL%20FISH%20CULTURE_0.pdf

15. Ornamental Fish Exporters (n.d.). Statistics. Available at: https://www.ornamentalfishexporters.com/industry-news/statistics/

Publisher's Note

IJLSCI remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.