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Research Article
Growth Performance, Feed Conversion and Survival of *Cirrhinus mrigala* with Feeding Rate in Cage System

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Abstract
Background and Objective: To maintain the current production rate with a consistent acceleration, more research on farming procedures, survival rate, feed conversion capability and growth performance of *Cirrhinus mrigala* in a confined cultural environment is needed. Therefore, this research aimed to determine the optimal feeding rate at which *Cirrhinus mrigala*, can develop at its best, with the highest survivability and feeding conversion capability in cages. **Materials and Methods:** A nine-week research was carried out to assess the growth and survivability of *Cirrhinus mrigala* in two separate cage treatments. The cages were all the same size and shape and the stocking density in each treatment was 280 per decimal. T_1 and T_2 received formulated feed and were fed 10 and 7% of their body weight, respectively. **Results:** The initial mean weight of fish was 25.4$\pm$1.63 g in each treatment. Net weight gain in T_1 and T_2 were found 44.4 and 35.4 g while mean weight gain in percentage was found 74.80 and 39.37% in T_1 and T_2, respectively. The mean final length attained at the time of harvesting in T_1 and T_2 were 17.9$\pm$0.26 and 17.5$\pm$0.44 cm where the initial length was 9.6$\pm$0.83 cm for both treatments. The FCR was found to be lower in T_2 than in T_1, with values of 5.78 and 4.62 in T_1 and T_2, respectively, in this study. Temperature, pH and DO were all between 30-32.5°C, 7.3-7.85 and 4.7-6.6 mg L^{-1}, respectively. In T_1 and T_2, survival rates were found to be 90 and 85%, respectively. **Conclusion:** *Cirrhinus mrigala* showed better growth and survival rates when fed 10% of their body weight (T_1) compared to 7% (T_2) in this experiment, indicating that a 10% feeding rate can be beneficial for cage culture.

Key words: Feeding rate, *Cirrhinus mrigala*, growth performance, cage, water quality

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Mrigal (*Cirrhinus mrigala*, Hamilton)[1], an Indo-Gangetic riverine carp, is one of three Indian large carp species commonly cultivated in Southeast Asian countries. This species has a long history of being used in polyculture with other native species, especially in India. However, records of its culture date from the early twentieth century. In the early 1940s, it was introduced for aquaculture to other areas of India outside its natural range, along with Catla (*Gibelion catla*) and Rohu (*Labeo rohita*) and in the 1950s and 1960s to Bangladesh, Pakistan, Myanmar, the Lao People's Democratic Republic, Thailand and Nepal[2] and has also been introduced into Sri Lanka, Vietnam, China, Mauritius, Japan, Malaysia, Philippines and the former USSR[3].

Cirrhinus mrigala (Mrigal) has established itself as one of the most important component species in pond culture due to its initially faster growth rate and compatibility with other carps. Mrigal is eurythermal, meaning this species can withstand temperatures as low as 14°C. Mrigal can grow up to 1 m in length[4]. The species usually reaches 600-700 g in the first year of cultivation, depending on stocking density and management practices. Mrigal grows more slowly than catla and rohu among the three big Indian carps[2].

Successful aquaculture depends exclusively on water quality, primary productivity, stocking density, culture system, fish species and quality of artificial feed and genetic variance of species. The primary productivity of a water body depends on some common physical factors such as temperature and transparency as well as chemical factors such as Dissolved Oxygen (DO), pH etc and without primary productivity aquatic production is not possible. Some researcher[5-10] explained the necessity of water quality for fish culture and mentioned the level of some physicochemical parameters like as temperature range is 25-32°C, transparency from 25-45 cm, DO from 5.0- 8.0 mg L^{-1} and pH from 6.5-8.5.

The right amount of feed must be given each time to prevent overfeeding or underfeeding the fish. The amount of feed to be given to the fish per day, known as the feeding rate (ration), is determined by the fish's weight. To meet their metabolic energy needs, fish change their food intake rates. The amount and quality of feed consumed has a significant impact on the growth rate, feed conversion efficiency and chemical composition. Shivagami *et al.*[11] recorded higher feed consumption at an 8% feeding regime and lower feed consumption at a 4% feeding regime in their experiment. Desai *et al.*[12], on the other hand, found that a 6% body weight/day ratio is ideal for common carp development at temperatures between 28 and 32 °C. The best growth output of *Cirrhinus mrigala* was recorded by Khan *et al.*[13], with the feed at 4-6% body weight of total biomass. Farming procedures, feed conversion ability, growth efficiency and survival rate among other things are important determinants of aquaculture success. That is why, while cultivating Mrigal in a restricted cultural context, it is critical to research these factors to maintain the current production rate at a consistent rate of acceleration. As a result, this study was carried out to learn about Mrigal's growth in response to commercial feed in various rations as well as to save money on feeding by observing the FCR value.

MATERIALS AND METHODS

Study area: For this experiment, an adjacent pond was used which located at Noakhali Science and Technology University (22°47 31 N 91°06 07 E) in Bangladesh and conducted during the period from 07 August to 13 October, 2017 for 9 weeks.

Experimental design: For nine weeks, the experiment was performed in an enclosure. Treatments 1 (T_1) and 2 (T_2) were used in the experiment, with feed rates of 10 and 7% of the fish's body weight, , respectively. Those two procedures were carried out in two separate cages with a 0.0723 decimal area and dimensions of 8×4×4 feet each. Between the cage and the embankment, there was a gap of 100 cm.

Preparing the water body before setting the cage: Manual uprooting of rooted weeds in the pond embankment. The hand net was used to keep track of floating weeds. For weed control, no chemicals were used. During the entire experiment, aquatic insects and other potentially harmful species like crabs were manually monitored. The installation of a bamboo pile in the dike helped to prevent soil erosion. The bottom was cleaned of excessive sedimentation.

Installed the cage: Bamboo, nylon net and jute fibre were used to make the cages which were all readily available in the region. The cage was designed to hold a one-meter distance between it and the dike. The pond bottom and the net bottom are separated by one foot.

Stocking of fry: The average length and weight of 40 days old fry were 9.60±.83 cm and 25.4±1.63 m, respectively, which are collected from a nearby fish hatchery. During the morning, fry were transported in an oxygenated polybag. Three days after setting up the experimental enclosure, the fry was acclimatized using the same pond water as the experiment. For both procedures, fish fry was stocked at a density of 20 per cage in Table 1.

Table 1: Stocking density in treatments (T_1 and T_2)

Treatment	Area of the cage (decimal)	No. of fish/ decimal	No. of fish/ cage
T_1	0.0723	280	20
T_2	0.0723	280	20

Table 2: Proximate Composition of supplemental feed fed to Mrigal

Feed ingredients	Amount of feed (%)
Fish meal	34.1
Mustard oil cake	16.2
Wheat flour	10.6
Bone meal	9.3
Cornflower	11.3
Rice bran	16.5
Starch	2.0
Total	100.0
Proximate analysis	
Crude protein	31.6
Crude fiber	37.8
Moisture	9.6
Fat	7.1
Ash	13.9

Management of feeding: Fish meal, mustard oil cake, wheat flour, cornflower, rice bran, bone meal and starch were used in this experiment to create a sinking diet. During the formulation of the feed, the diameter size was kept constant at 2.00.3 mm. The diet used in the experiment had a nutritional composition of 94% Dry Matter (DM), with 31.6% Crude Protein (CP), 37.8% Crude Fiber (CF), 7.1% fat and 13.9% ash in Table 2. In this experiment, the protein was determined using the Kjeldahl method, fat was determined using the Soxhlet method, moisture was determined using the oven drying method, fibre was determined using the acid detergent method and ash was determined using the muffle furnace method. Directly thronging from hand, the feed was spread uniformly over the surface of the water inside the cage. The first half of the ration was provided at 8 am and the second half was provided at 4 pm. The amount of feed to be given adjusted after calculating the biomass of the cage every week.

Sampling and measurement: A scope net was used to capture the fish and a scale and a digital balance (Lutron GM-600.0 g×0.1 g) were used to measure the length and weight of each fish. To reduce sampling error, 30% of the total fish were sampled at each period. A pH meter (model: HANNA-HI96107) was used to calculate the pH of the water. A portable DO meter (Lutron-DO-5509) was used to measure dissolved oxygen twice a week The following formula was used to measure growth efficiency (weight and length), survival rate, Specific Growth Rate (SGR) and Feed Conversion Ratio (FCR) in this experiment[14]:

$$\text{Mean weight gain (\%)} = \frac{\text{Mean final weight gain (g)} - \text{Mean initial weight (g)}}{\text{Mean initial weight}} \times 100$$

$$\text{Survival rate (\%)} = \frac{\text{Number of harvested fish}}{\text{Initial number of fish}} \times 100$$

$$\text{SGR (\%)} = \frac{\text{In}\left(\text{Final weight}\right) - \left(\text{Initial weight}\right)}{\text{Culture period (days)}} \times 100$$

$$\text{FCR} = \frac{\text{Amount of feed given by dry weight during the experimental period}}{\text{Final live weight gain by the fish}}$$

Statistical analysis: All data were subjected to make graph and table using MS Excel.

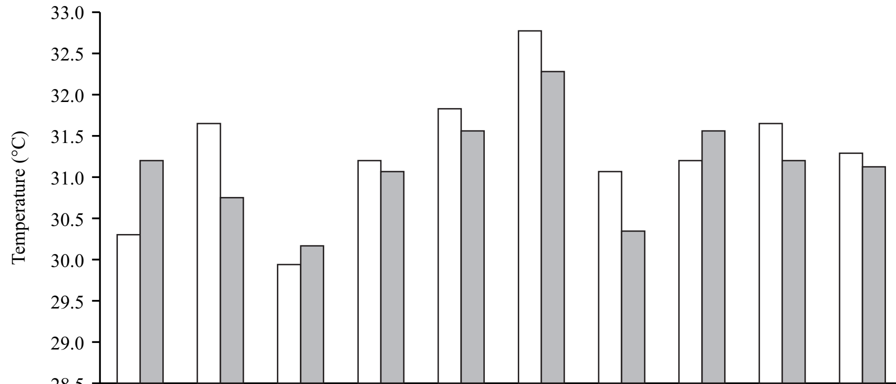
RESULTS AND DISCUSSION

Water quality parameters: Physical, chemical and biological environmental parameters were interrelated in a complicated sequence of physiochemical reactions[15] and each aspect of fish culture was affected (survival, growth and reproduction). Temperature, pH and dissolved oxygen changed over time in this experiment but clarity remained nearly constant. T_1 and T_2 had weekly average temperatures of 31.3±1.001 and 31.1±0.661 °C, respectively in Fig. 1. The experimental cage temperature was within the appropriate range for culture ponds, which is consistent with the other findings[16-18] but the temperatures of both cages were slightly higher for mrigal culture[4,19].

In T_1 and T_2, the weekly average pH ranged from 7.22-7.85 and 7.27-7.74, respectively, with mean (SD) values of 7.52±0.186 and 7.483±0.149 Fig. 2. The pH values of both T_1 and T_2 agree well with the findings[4-6,9].

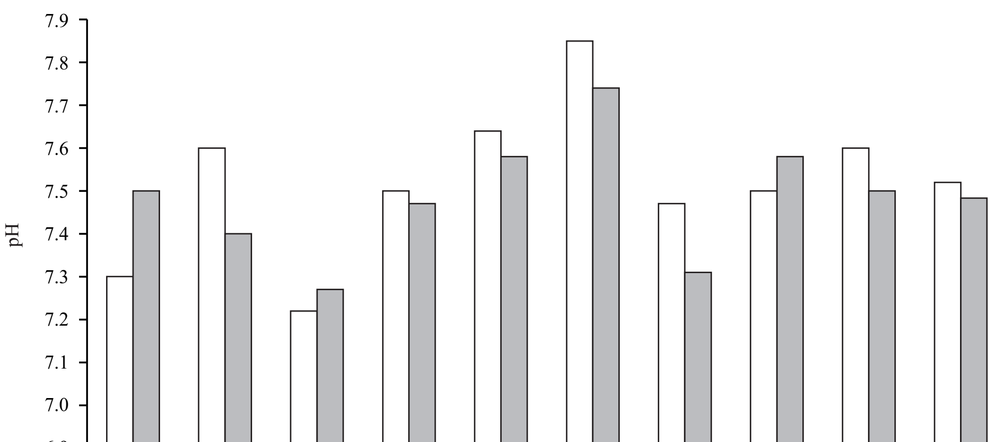
The weekly average DO (mg L^{-1}) was ranged from 5.0-6.6 and 4.7-7.2 mg L^{-1} with a mean SD value of 5.71±0.592 and 5.667±0.795 mg L^{-1} in T_1 and T_2, respectively in Fig. 3. The level of Dissolved Oxygen (DO) was within the acceptable range in this study in accordance with the other studies[4,7,10].

Growth performance: The growth curve was upper in T_1 compare to T_2 in Fig. 4. T_1 and T_2 achieved average final weights of 69.8±7.3 and 60.8±9.09 g, respectively, at harvest, where the initial weight was 25.4±1.63 g for both treatments (Fig. 5). Shivagami *et al.*[11], who discovered that Mrigal showed developed better in higher feeding rations



	1st week	2nd week	3rd week	4th week	5th week	6th week	7th week	8th week	9th week	Avg.
T_1 temperature (°C)	32	32.5	30.0	31.5	30.8	30.0	32.0	32.5	30.6	31.322
T_2 temperature (°C)	31.5	32.0	31.0	31.0	30.2	32.2	31.0	31.0	30.4	31.144

Fig. 1: Weekly average temperature in both treatments



	1st week	2nd week	3rd week	4th week	5th week	6th week	7th week	8th week	9th week	Avg.
T_1 pH	7.3	7.6	7.22	7.5	7.64	7.85	7.47	7.5	7.6	7.52
T_2 pH	7.5	7.4	7.27	7.47	7.58	7.74	7.31	7.58	7.5	7.483

Fig. 2: Weekly average pH in both treatments

than lower feeding rations, agreed with this study. During the study period, T_1 and T_2 had net weight gains of 44.4 and 35.4 g, respectively in Fig. 5. In T_1 and T_2, weekly weight gain ranged from 3.6-6.4 and 2.8-4.8 g, respectively, with mean SD values of 4.93±0.75 and 3.93±0.72 g in Table 3. In other studies, the weight gain of Mrigal was 62-81[20] and 57.06 g[21] which was close to the present treatment of T_1. Observed in the present study, mean weight gain in percentage was 74.80 and 39.37% in T_1 and T_2 respectively and another finding was 13.64-85.71% in case Indian major carps[11]. Mean final weight and net weight gain of both T_1 and T_2 based on mean initial weight are given in Fig. 5 which showed the comparison between the growth performance of Mrigal.

The Specific Growth Rate (SGR) of mrigal in T_1 and T_2 were found 1.6±0.71 and 1.38±0.50% respectively in Table 4. The SGR value in both treatments was lower compare to the findings of Biswas *et al.*[20], Zhen-Yu *et al.*[21], Desai *et al.*[12], Abdelghany *et al.*[22], Jena *et al.*[23], Hossain *et al.*[17] and Sahu *et al.*[4]

Table 3: Weekly weight gain of mrigal, (*Cirrhinus mrigala*)

	Weight gain (g)/weeks								
Treatment	1st	2nd	3rd	4th	5th	6th	7th	8th	9th
T_1	6.4	5.4	4.4	3.6	5.2	4.8	5.0	4.8	4.8
T_2	4.8	4.0	3.2	3.2	4.8	2.8	4.4	4.2	4.0

Table 4: Specific growth rate of both T_1 and T_2 treatments

	SGR (%) (weeks)									
Treatment	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	Avg.
T_1	3.21	2.24	1.60	1.19	1.55	1.30	1.24	1.10	1.02	1.6±0.71
T_2	2.47	1.77	1.27	1.17	1.60	0.85	1.24	1.10	0.97	1.38±0.5

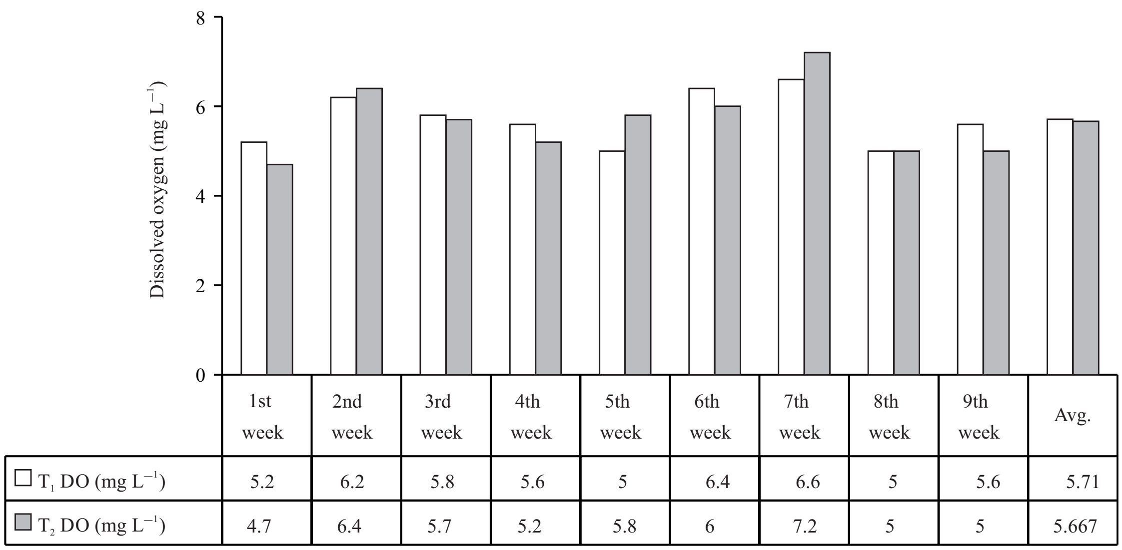


Fig. 3: Weekly average dissolved oxygen in both treatments

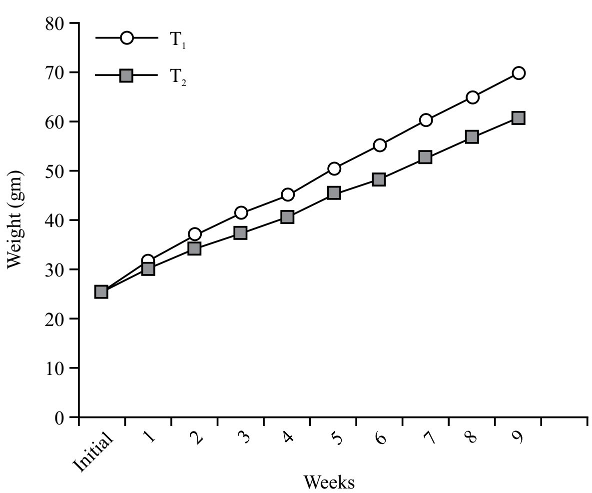


Fig. 4: Mean body weight in gram changes of different treatments at a week interval

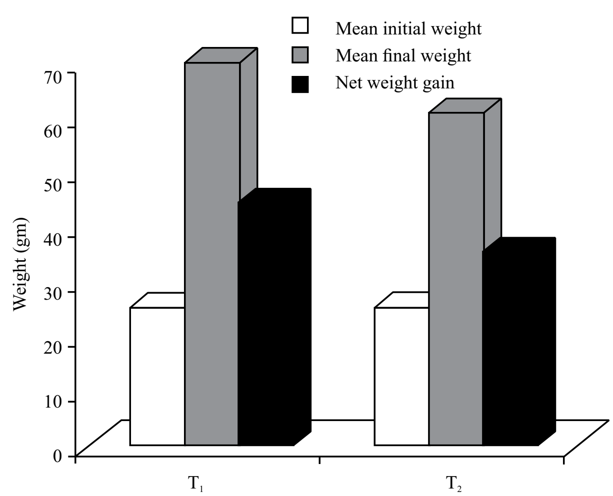


Fig. 5: Comparison among mean initial body weight, final body weight and net weight gain between the treatments (T_1 and T_2)

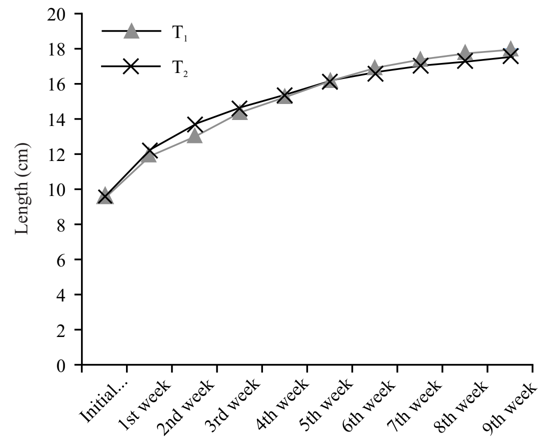


Fig. 6: Mean body length changes of different treatments (T_1 and T_2) at a week interval

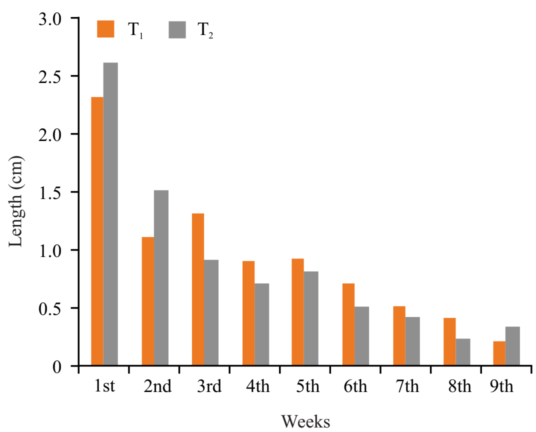


Fig. 7: Weekly length gain comparison between T_1 and T_2

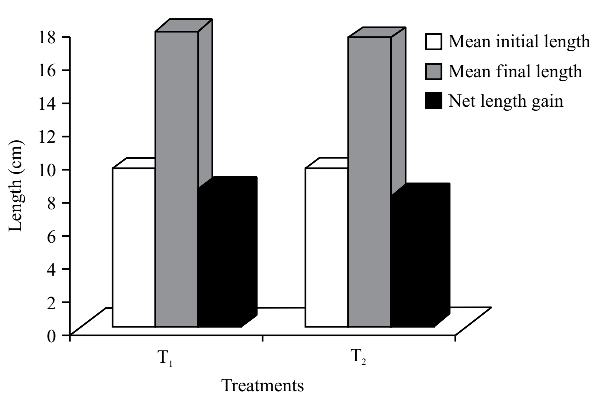


Fig. 8: Mean initial body length, final body length and net length gain between the treatments

where they found the SGR of Indian major carps (rohu, catla, mrigal) and common carps usually ranged between 2.0-4.0%.

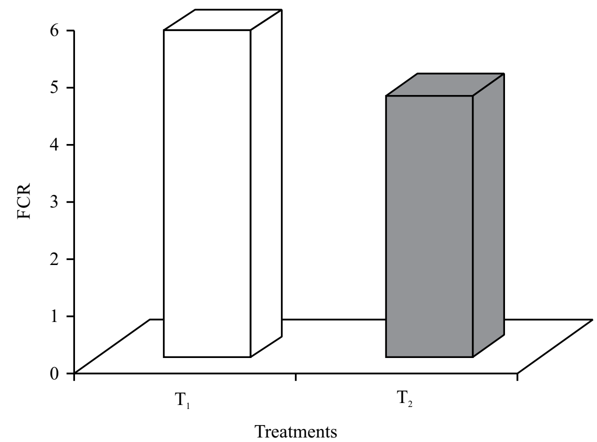


Fig. 9: Comparison between FCR values of T_1 and T_2

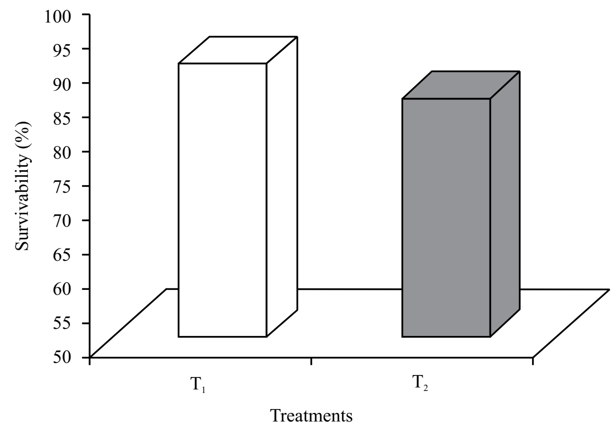


Fig. 10: Comparison between survivability of T_1 and T_2

T_1 had the highest length (18.2 cm) compare to and T_2 (17 cm) at the harvesting period in Fig. 6. This study showed similarities with the findings of Ayyappan and Jena[2] and Hossain *et al.*[17], they showed the length of mrigal had a tendency to increase in higher feeding ratio. Weekly average length gain ranged from 0.2-2.3 and 0.2-2.6 cm with mean SD value of 0.92±0.62 and 0.87±0.75 cm in T_1 and T_2 respectively in Fig. 7. Net length gain for both T_1 and T_2 were found 8.3 and 7.9 cm respectively in Fig. 8. The range of final length was found to vary from 17.5-18.2 cm and 17-18.1 cm respectively in T_1 and T_2 where the average length was 17.9±0.26 and 17.5±0.44 cm at harvest, respectively but the initial length was 9.6±0.83 cm for both treatments (Fig. 8). In the first four weeks, both T_1 and T_2 treatments displayed a greater average weekly weight gain.T_1showed a higher average weekly gain than T_2 similar to the findings with Shivagami *et al.*[11].

Feed conversion ratio: The FCR was lower in T_2 than in T_1, FCR was found 5.78 and 4.62 in T_1 and T_2 respectively in Fig. 9. The

FCR of both treatments were higher in comparison with the study of Khan *et al.*[13] in which he found that Mrigal showed higher FCR with the use of 4-6% body weight feed. The present study showed dissimilarities with the result of Shivagami *et al.*[11] and Biswas *et al.*[20], where they found FCR value 3.02 and 0.65-0.91 at the different feeding ration of total body weight. FCR values of T_2 treatments showed close to the other studies[24-26] where they found that FCR values of Indian major carps ranged from 1.97-4.91.

Survival rate of *C. mrigala*: T_1 also had the highest survival rate, while T_2 had the lowest. In T_1 and T_2, survival was found to be 90 and 85%, respectively, while the initial stocking number of fish was 20 in both treatments in Fig. 10. Similar finding (83.9-91.7%) were reported by Sahu *et al.*[4] and was dissimilar studies (27.12-48.02)[20].

CONCLUSION

In this experiment, fish in treatment 1 (T_1) grew faster than other treatment 2 (T_2), where feed was given at a rate of 10% of the fish's body weight. So, based on the current experimental situation, Mrigal growth is higher in high feeding percentages.

SIGNIFICANCE STATEMENT

This study discovered the growth performance of *C. mrigala* in cages that can be beneficial for fish culturists. Feed ratio has been improved in the present study which ultimately leads to higher production of this species. This study will help the researchers to uncover the critical areas of the feasibility of mrigal culture in the cage with different feeding rate that many researchers were not able to explore in the past. Thus a new theory on the growth improvement of *C. mrigala* may be arrived at by the present research.

REFERENCES

1. Joardar, S.N., T.J. Abraham and N. Mandal, 2015. Indian major *Carpcirrhinus mrigala* (Hamilton, 1822) inoculated with live *Aeromonas hydrophila* shows dynamic changes in specific immune-cellular activities. J. Immunol. Immunopathol., 17: 25-30.
2. Ayyappan, S. and J.K. Jena, 2003. Grow-out production of carps in India. J. Applied Aquacult., 13: 251-282.
3. Yu, F.D., D.E. Gu, Y.N. Tong, G.J. Li and H. Wei *et al.*, 2019. The current distribution of invasive mrigal carp (*Cirrhinus mrigala*) in Southern China and its potential impacts on native mud carp (*Cirrhinus molitorella*) populations. J. Freshwater Ecol., 34: 603-616.
4. Sahu, P.K., J.K. Jena, P.C. Das, S. Mondal and R. Das, 2007. Production performance of *Labeo calbasu* (Hamilton) in polyculture with three Indian major carps *Catla catla* (Hamilton), *Labeo rohita* (Hamilton) and *Cirrhinus mrigala* (Hamilton) with provision of fertilizers, feed and periphytic substrate as varied inputs. Aquaculture, 262: 333-339.
5. Das, P.C., S. Ayyappan and J. Jena, 2005. Comparative changes in water quality and role of pond soil after application of different levels of organic and inorganic inputs. Aquacult. Res., 36: 785-798.
6. Hossain, M.Y., M.M. Rahman, S. Jasmine, A.H.M. Ibrahim and Z.F. Ahmed *et al.*, 2008. Comparison studies on water quality and plankton production between perennial and non-perennial ponds in Bangladesh. J. Fish. Aquatic Sci., 3: 176-183.
7. Bhatnagar, A. and G. Singh, 2010. Culture fisheries in village ponds: A multi-location study in Haryana, India. Agric. Biol. J. North Am., 1: 961-968.
8. Rahman, M.M., M. Verdegem and M.A. Wahab, 2008. Effects of tilapia (*Oreochromis nilotica* L.) stocking and artificial feeding on water quality and fish growth and production in rohu-common carp bi-culture ponds. Aquaculture Res., 39: 1579-1587.
9. Doulaha, M.A.U., M.H.O. Rashida, S.M.M. Islam, M.S. Rahmana, M.S. Islam and N.A. Raushon, 2019. Growth and survival performance of Mrigal *Cirrhinus mrigala* fingerlings in high temperature at laboratory condition. Res. Agric. Livest. Fish., 6: 415-420.
10. Sharma, K.K., B.C. Mohapatra, P.C. Das, B. Sarkar and S. Chand, 2013. Water budgets for freshwater aquaculture ponds with reference to effluent volume. Agric. Sci., 4: 353-359.
11. Sivagami, K. and J. Ronald, 2016. Effect of different probiotic enriched diets on growth performance of *Cirrhinus mrigala* fingerlings Int. J. Fish. Aquacult. Sci., 6: 87-97.
12. Desai, A.S. and R.K. Singh, 2009. The effects of water temperature and ration size on growth and body composition of fry of common carp, *Cyprinus carpio*. J. Thermal Biol., 34: 276-280.
13. Khan, M.A., I. Ahmed and S.F. Abidi, 2004. Effect of ration size on growth, conversion efficiency and body composition of fingerling mrigal, *Cirrhinus mrigala* (Hamilton). Aquacult. Nutr., 10: 47-53.
14. Hussein, M.S., A. Zaghlol, N.F.A.E. Hakim, M.E. Nawsany and H.A. Abo-State, 2016. Effect of different growth promoters on growth performance, feed utilization and body composition of common carp (*Cyprinus carpio*). J. Fish. Aquat. Sci., 11: 370-377.
15. Mohapatra, B.C., L. Das, S.K. Mahanta, H. Sahu, P. Sahoo, S. Lenka and K. Anantharaja, 2017. Oxygen consumption in fry and fingerling stages of Indian major carps analysed using indigenously developed respirometer. Indian J. Fish., 64: 91-94.

16. Craig, J.F., A.S. Halls, J.J.F. Barr and C.W. Bean, 2004. The Bangladesh floodplain fisheries. Fish. Res., 66: 271-286.
17. Hossain, M.Y., S. Jasmine, A.H.M. Ibrahim, Z.F. Ahmed and J. Ohtomi *et al*., 2007. A preliminary observation on water quality and plankton of an earthen fish pond in Bangladesh: Recommendations for future studies. Pak. J. Biol. Sci., 10: 868-873.
18. Rai, S., A.M. Shahabuddin, Y. Yi, A.N. Bart and J.S. Diana, 2012. Effect of various loading rates of rice straw on physical, chemical and biological parameters of water. J. Fish. Aquatic Sci., 7: 364-378.
19. Joseph, I., 2009. Important Management Measures in Cage Culture. In: National Training on 'Cage Culture of Seabass' Held at CMFRI, Kochi. Joseph, I. (Ed.). Central Marine Fisheries Research Institute, pp: 50-56.
20. Biswas, G., J.K. Jena, S.K. Singh, P. Patmajhi and H.K. Muduli, 2006. Effect of feeding frequency on growth, survival and feed utilization in mrigal, *Cirrhinus mrigala* and rohu, *Labeo rohita* during nursery rearing. Aquaculture, 254: 211-218.
21. Du, Z.Y., Y.J. Liu, L.X. Tian, J.G. He, J.M. Cao and G.Y. Liang, 2006. The influence of feeding rate on growth, feed efficiency and body composition of juvenile grass carp (*Ctenopharyngodon idella*). Aquacult. Int., 14: 247-257.
22. Abdelghany, A.E. and M.H. Ahmad, 2002. Effects of feeding rates on growth and production of Nile tilapia, common carp and silver carp polycultured in fertilized ponds. Aquacult. Res., 33: 415-423.
23. Jena, J.K., S. Ayyappan, P.K. Aravindakshan, B. Dash, S.K. Singh and H.K. Muduli, 2002. Evaluation of production performance in carp polyculture with different stocking densities and species combinations. J. Applied Ichthyology, 18: 165-171.
24. Iqbal, K.J., M. Ashraf, F. Abbas, A. Javid and F. Rassol, 2014. Effect of plant-fishmeal and plant by-product based feed on growth, body composition and organoleptic flesh qualities of *Labeo rohita*. Pak. J. of Zool., 46: 253-260.
25. Ahmed, M.S., K. Shafiq and M.S. Kiani, 2012. Growth performance of major carp, *Labeo rohita* fingerlings on commercial feeds. J. Anim. Plant Sci., 22: 93-96.
26. Ashraf, M., M. Ayub and A. Rauf, 2008. Effect of different feed ingredients and low temperature on diet acceptability, growth and survival of mrigal, *Cirrhinus mrigala*, fingerlings. Pak. J. Zool., 40: 83-90.