Effect of feeding schedule on growth and production of fish under polyculture system

MALOBICA DAS TRAKROO, HEMA TEWARI, RIKHI SINGH CHAUHAN, MOHD. DANISH AND RITU AGARWAL

College of Fisheries, G. B. Pant University of Agriculture and Technology, Pantnagar.
e-mail- tewari10@gmail.com

ABSTRACT

In aquaculture, feed is often considered as the single largest cost item and represents over 50% of the operating cost. One approach to reduce feed cost is to develop appropriate feeding management strategies thereby reducing the wastage. The trials were carried out in FRP tanks. The water quality parameters of different treatments in both the trials i.e fry to fingerling rearing and fingerling to table size fish rearing, were found to be more or less similar and all of them were within the acceptable ranges for fish culture. Several growth parameters (Weight gain, Specific growth rate, Food conversion ratio, Condition Factor etc) were calculated. Feeding frequency of four times a day (9:00 am, 11:30 am, 2:00 pm and 5:00 pm) was found to be best for effective growth and nutrient utilization for the carp post larvae in the nursery ponds and feeding frequency of two times a day (9:00 AM, and 5:00 PM) was found to be best for fish in the grow out pond.

Keywords: *Polyculture, Feeding frequency, Fingerlings.*

INTRODUCTION

In aquaculture, feed is often considered as the single largest cost item and represents over 50% of the operating cost. The general approach to reduce feed cost has been to develop low cost diets (Webstar *et al.*, 1992; Ahmed *et al.*, 1996; Kader *et al.*, 2003, Azad *et al*., 2004, Mandal and Das, 2014). One approach to reduce feed cost is to develop appropriate feeding management strategies thereby reducing the wastage. A lot of different fish feeds available in the market are used for culturing carps. The efficiency and utilization of feed are very important considerations. Various studies have indicated that there is an optimum frequency above which additional feeding produce no advantage (Nandeesha *et al.*, 1993, 1994 and 2002, Guinea and Fernandes1997, Hump *et al.*, 1998,, Patel and Yakupitiyage, 2003, Sevgili *et al.*, 2004).Since carps are cultured in earthen ponds, fish are generally hand fed once daily. Thus the study aimed to assess suitable feeding time(s) as well as feeding frequency for carps under semi-intensive composite farming system in Tarai agro climatic zone.

MATERIALS AND METHODS

The experiments were conducted at Carp Seed Production Unit of College of Fisheries; G.B. Pant University of Agriculture & Technology, Pantnagar .The two trials were conducted in FRP tanks each with a full volume of 4000 liters. A 6" thick bed of soil was laid at the bottom of each tank. Each tank was equipped with a feeding tray. Aeration facility was also provided. Water levels in all the tanks were maintained at 75 cm thought the experimental period. The tank preparation was done with liming (20mg/l) and then manuring was done using cow dung (500 mg/l). Urea (2.5mg/l) and single super phosphate (5.0 mg/l) were added after two days. Experimental diets for fry (40% protein) and fingerling (32% protein) were formulated for rearing fry for fingerling production and fingerling for table size fish production using locally available feed ingredients (rice polish, mustard oil cake, sunflower oil cake, soybean oil cake and fish meal). Rearing of fry for fingerling production was carried out in 15 FRP tanks with five treatments each with 3 replicates for 90 days. Rearing of fingerlings for table size fish production was done under four treatments each with 3 replicates.

The fries (0.9-1.4 g weight and 2.3-3.0 cm length) of Indian major carps, rohu (*Labeo rohita*) ,Catla (*Catla catla*) and Nain (*Cirrhinus* m*rigal*a) and exotic carps, Silver carp (*Hypophthalmichthys moloitrix*), Grass carp (*Ctenopharyngodon idella*) and Common carp (*Cyprinus carpio*) were procured from the Carp Seed Production Unit of the College itself. The fries were stocked at a density of 60 fries / m^3 while fingerlings were stocked at a stocking density 1/ m^3 in all the tanks. The ratio of stocking the six species of fish was 20:15**:**25:10**:**20:10 (catla: silver carp: rohu: grass carp: nain: common carp). Under yard trial of fry rearing for fingerling production, the feed was supplied at 8-10 percent of the body weight of the fish. Feeding frequency was once a day (9.00 am), twice a day (9:00 am and 5:00 pm), three times a day (9:00 am, 1:00 pm and 5:00 pm), four times a day (9:00 am, 11:30 am, 2:00 pm & 5:00 pm) and five times a day (9 am, 11 am, 1 pm, 3 pm and 5 pm). Initially feed was broadcasted over water surface (10% of body weight) by hand but after a month feed was made into dough and served as balls in the feeding trays (8% body wt.). Under yard trial of fingerling (6.4- 9.4 g weight and 6.2-8.4 cm length) rearing for production of table sized fish, the feed was supplied at a rate of 5% of the body weight for initial three months and then it was reduced to 3% of body weight. Feeding frequency was once every two days (9.00 am), once a day (9.00 am), twice a day (9.00 am and 5.0 am) and three times a day (9.00am, 1.00pm, 5.00 pm). 5-6 fishes were sampled fortnightly to monitor growth in terms of length and weight.

The water quality parameters such as temperature, dissolved oxygen (DO), free Carbon-dioxide, total alkalinity and pH were measured every third day while NH3 –N, NO3 – N and PO4- P were analyzed forthrightly (APHA, 2005). Plankton sampling was done fortnightly by filtering 15 liters of water and estimated quantitatively (APHA, 2005). The growth performances in terms of weight gain, specific growth rate (SGR), food conversion ratio (FCR) and condition factor (K) were calculated using standard formulae. The data values

for weight gain, survival, SGR, FCR and condition factor were statistically analyzed using single factor analysis of variance (ANOVA).

RESULTS AND DISCUSSION

The details of hydro biological conditions of the experimental tanks are depicted in fig 1 –8.The water quality parameters of different treatments in both the trials i.e fry to fingerling rearing and fingerling to table size fish rearing, were found to be more or less similar and all of them were within the acceptable ranges for fish culture. The water temperature ranged from 27.8 to 31.8, pH was 7.1- 7.9 The mean DO contents ranged from 2.8 mg/ l-7.9, free CO2 content was fluctuating between 2- 25 mg/l. Ammonia nitrogen (NH_3 –N) content was ranging from 0.28 mg/ l to 0.35 mg/ l initially in the experimental tanks it may be due to unutilized feed as the fishes were not tamed initially. After about 15-20 days the NH3- N range come down to 0.14 to 0.22 mg/ l. Nitrate nitrogen (NO_3 -N) and Phosphate Phosphorus (PO_4- P) in the tanks were fluctuating between 0.6 to 1.2 mg/ l and 0.15 to 0.38 respectively. Soil bed provision and fertilization of the tanks augmented sufficient natural food in the water. Plankton density ranged from 564 to 1375 units/l in the experimental tanks. The growth performances in terms of weight gain, feed conversion ratio, specific growth rate survival and condition factor were calculated and given in the table 3and 4. Maximum weight gain of the fishes under nursery rearing trial was recorded in T_3 (5.43g) followed by T_4 (5.33g) but was statistically insignificant from each other. Minimum value regarding weight gain was recorded in T_0 (3.61g) which was significantly different fromT_2, T_3 & T_4. Highest specific growth rate values (SGR) of the fishes were recorded in T_3 (1.80) followed by T_4 (1.66) but were statistically insignificant from each other while lowest SGR was recorded in control group. There is also a significant difference among other treatments. Significantly high feed conversion ratio (FCR) was observed in fishes of T3 group Maximum condition factor values (1.35) was recorded in T_3 group which is significantly different from other feeding groups. The survival rates were 83.73%, 82.36%, 82.36%, 85.26% and 80.73% for the fishes in T_0, T_1, T_2, T_3 and T_4 groups respectively. The survival rates didn't show any significant variation among treatments.

In the trial of fingerling rearing to table size fish rearing, maximum weight gain of the fishes were recorded in T_3 (252g)) followed by T_2 (232g) but were found statistically insignificant from each other. Highest specific growth rate values SGR of the fishes were recorded in T_3 (1.78) followed by T_2 (1.58) but were statistically insignificant from each other while lowest SGR was recorded in control group. There is also a significant difference among other treatments. Significantly high feed conversion ratio (2.25) was observed in fishes of T3 group (Table-3). Significantly high survival rate was observed in T2. Survival rates didn't show any significant variation among other treatments. Maximum condition factor value (1.31) was recorded in T_2 group which is significantly different from other feeding groups.

A simple analysis of trials show that the fish fed at higher frequency gained more weight than fish fed at lower feeding frequency. There is significant effect of feeding frequency on weight gain and FCR in fishes. It can be summed up that a feeding frequency of three and four times a day in the nursery ponds and two to three times a day in the grow out ponds compared to other experimental groups in our study seemed best for effective growth and nutrient utilization but water quality parameters indicate that

water conditions were better in T_3 than in the T_4 (nursery rearing trial) and T2 than in T3 (grow out rearing trial). It was evident that T_3 and T_4 (nursery) and T2 and T3 (grow out) groups were not significantly different from each other but increased feeding frequency will incur more labour charges affecting the economic feasibility of feeding. Therefore taking into consideration the pond water quality conditions and economic feasibility, feeding frequency of four times a day (9:00 am, 11:30 am, 2:00 pm and 5:00 pm) was found to be best for effective growth and nutrient utilization for the carp post larvae in the nursery ponds and feeding frequency of two times a day (9:00 AM, and 5:00 PM) was found to be best for fish in the grow out ponds.

Table 1a

Feeding schedule (frequency and time) of fries

Treatment	**T_0 Control**	**T_1**	**T_2**	**T_3**	**T_4**
Frequency/ time	**Once a day**	**Two times daily**	**Three times daily**	**Four times daily**	**Five times daily**
9:00 am	✓	✓	✓	✓	✓
11:00 am	–	–	–	–	✓
11:30 am	–	–	–	✓	–
1:00 pm	–	–	✓	–	✓
2:00 pm	–	–	–	✓	–
3:00 pm	–	–	–	✓	✓
3:30 pm	–	–	–	–	–
5:00 pm	–	✓	✓	✓	✓

Table 1b

Feeding schedule (frequency and time) of fingerlings

Treatment	**T_0 Control**	**T_1**	**T_2**	**T_3**
Frequency/ time	**Once a day**	**Once in two days**	**Two times daily**	**Three times daily**
9:00 am	✓	✓	✓	✓
3:00 pm	–	–	–	✓
5:00 pm	–	–	✓	✓

Table 2

Weight gain, Food Conversion Rate, Specific Growth Rate, Condition Factor and Survival Rate in different feeding groups during experimental period (fry to fingerling rearing)

Parameters	**T0**	**T1**	**T2**	**T3**	**T4**
Weight gain	3.61 ± 0.2^{a}	3.96 ± 0.22^{a}	4.45 ± 0.54^{b}	5.43 ± 0.2^{c}	5.33 ± 0.17^{c}
Food Conversion Rate	2.50 ± 0.2^{a}	2.56 ± 0.25^{a}	2.60 ± 0.1^{a}	2.20 ± 0.2^{b}	2.60 ± 0.2^{a}
Specific Growth Rate	0.99 ± 0.18^{a}	1.16 ± 0.04^{a}	1.43 ± 0.12^{b}	1.80 ± 0.15^{c}	1.66 ± 0.11^{bc}
Condition Factor	1.19 ± 0.03^{a}	1.28 ± 0.07^{a}	1.28 ± 0.12^{a}	1.35 ± 0.09^{b}	1.29 ± 0.03^{a}
Survival Rate	83.73 ± 6.57^{a}	82.36 ± 4.36^{a}	82.36 ± 4.36^{a}	85.26 ± 2.82^{a}	80.73 ± 2.19^{a}

Values with same superscript are not significantly different from each other as per ANOVA.

Table 3
Weight gain, Food Conversion Rate, Specific Growth Rate, Condition Factor and Survival rate in different feeding groups during experimental period (fingerling to table size rearing)

Parameter	T0	T1	T2	T3
FCR	2.35±0.20[a]	2.34±.23[ab]	2.43±0.22[ab]	2.25±0.20[b]
SGR	1.35±0.03[ab]	1.37±0.03[a]	1.58±0.14[b]	1.78±0.16[b]
CF	1.27±0.03[ab]	1.29±0.07[a]	1.31±0.03[b]	1.30±0.03[a]
Weight Gain (gram)	210±9.53[b]	208±9.21[b]	232.3±9.14[a]	252.3±9.02[b]
Survival (%)	89.04±6.89[a]	85.09±2.83[a]	87.82±3.14[b]	85.24±2.81[a]

Tank water conditions in the first trial (Rearing of fry to fingerling)

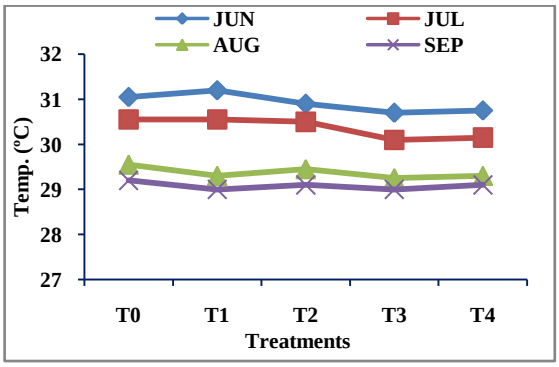


Fig.1 : Variations in Temperature (°C) in different treatments during experimental period

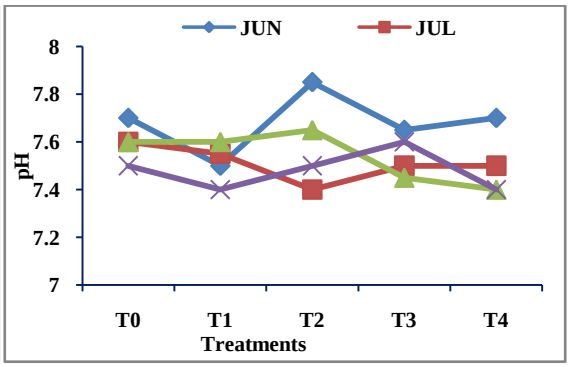


Fig.2: Variations in pH in different treatments during period

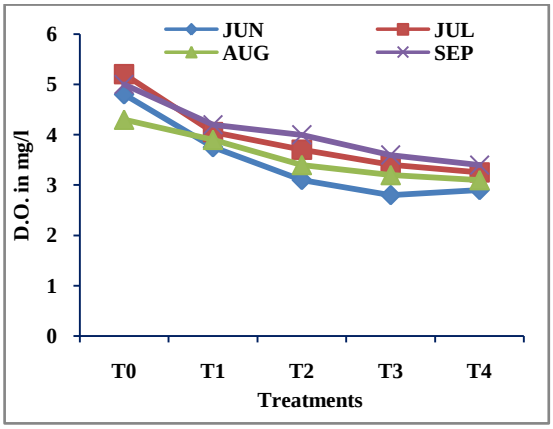


Fig. 3: Variations in Dissolved Oxygen (mg/l) in different treatments during experimental period

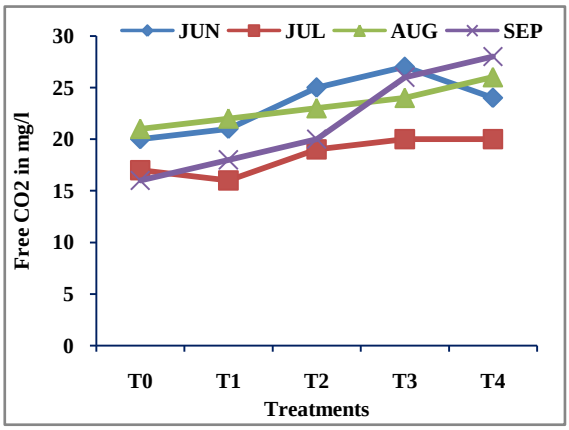


Fig.4: Variations in Free CO2 (mg/l) in different treatments during experimental period

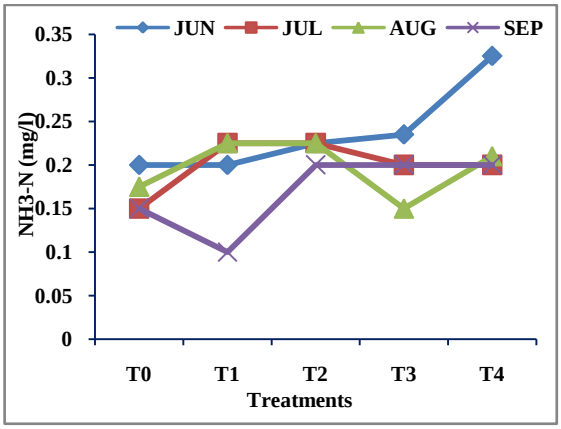


Fig.5: Variations in Alkalinity (mg/l) in different treatments during experimental period

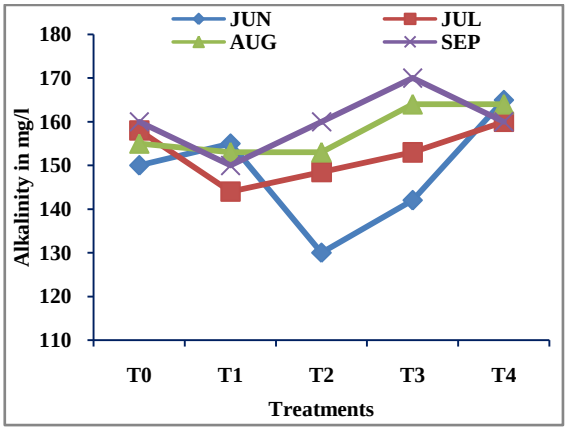


Fig. 6: Variations in NH3-N in different treatments during experimental period

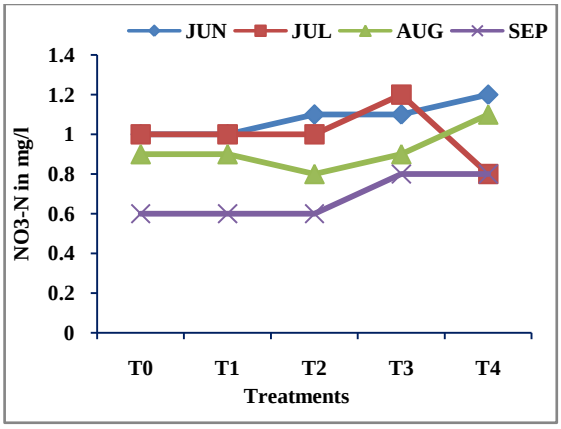


Fig.7: Variations in NO3-N (mg/l) in different treatments during experimental period

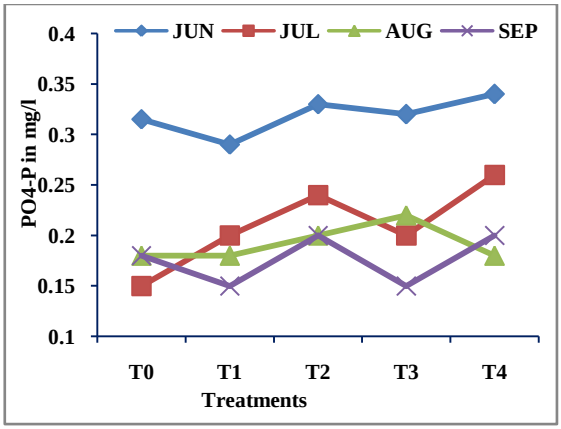
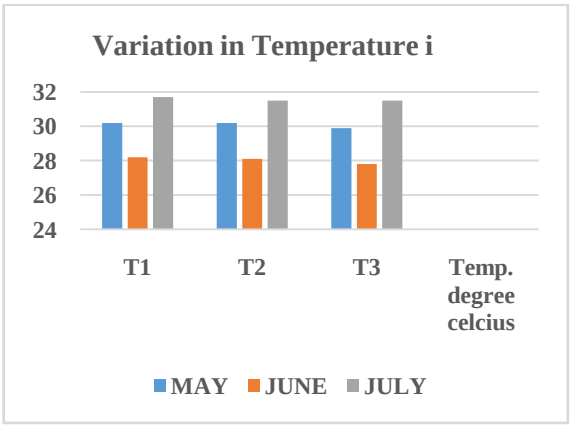
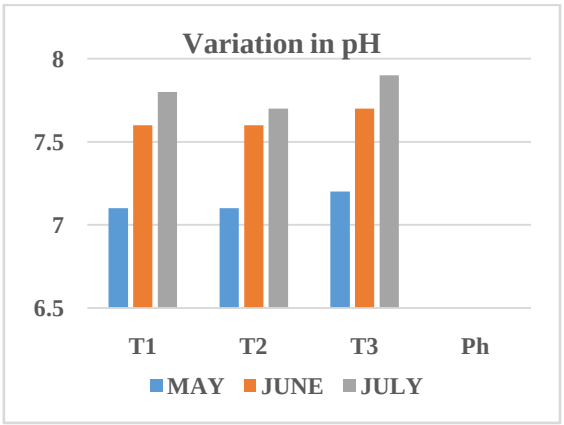
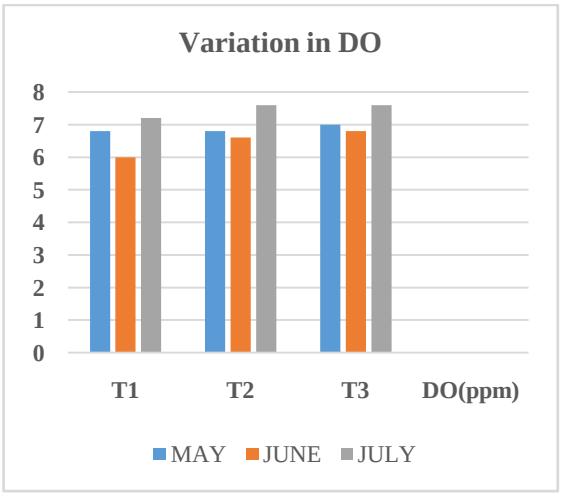


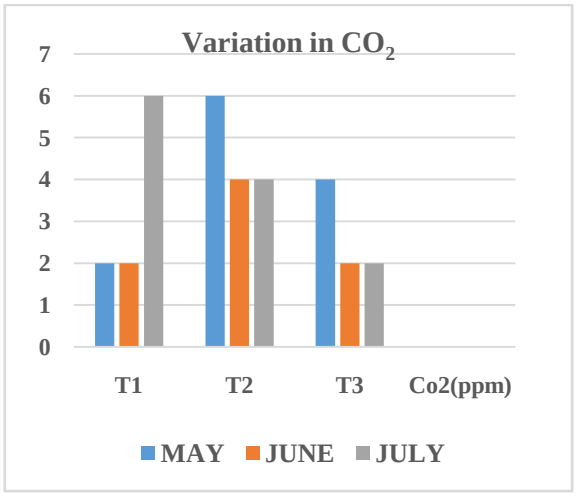
Fig. 8: Variations in PO4-P (mg/l) in different treatments during experimental period

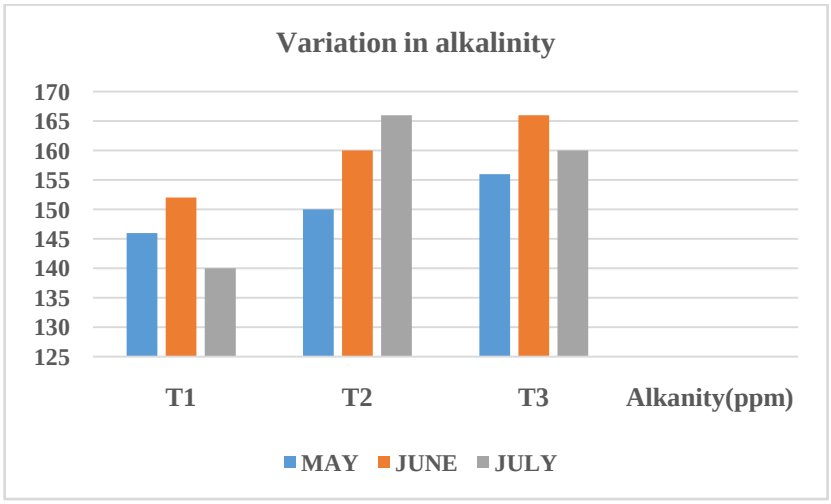
Tank water conditions in the second trial (Rearing of fingerlings to table sized fish)











ACKNOWLEDGEMENTS

The research was financially supported by Uttarakhand Council of Science and Technology, Dehradun, Uttaranchal under the project "Effect of feeding schedule in carp farming". We are grateful to Dean, College of Fisheries, Pantnagar for providing facilities to carry out this project successfully.

REFERENCES

1. Ahmed, G.U., Sarder, M.R.I. and Kibria, M.G. 1996. Culture feasibility of Pangus (*Pangasiuspangasius* Ham.) in earthen ponds with different supplemental diets. *Bangladesh J. Fish*., 19(1-2): 23-37.
2. Ali, M.Z., Hossain, M.A. and Mazid, M.A. 2005. Effect of mixed feeding schedules with varying dietary protein levels on the growth of sutchi catfish, *Pangasius hypophthalmus* (Sauvage) with silver carp, *Hypophthalmichthys molitrix* (Valenciennes) in ponds. *Aquacult. Res.*, 36: 627-634.
3. Azad, M.A.K., Rahman, M.R., Rahman, Z., Kader, M.A., Haque M.M. and Alam, M.J. 2004. Polyculture of carp, tilapia and pangas using low cost inputs. *Pak. J. Biol. Sci*., 7(11): 1918-1926.
4. APHA, 1995 *Standard methods for the examination of water and waste water* (Washington, New York: 19th Edition, American Public Health Association,).

5. Cho C. Y., Bureau D. P**.** 2001. A review of diet formulation strategies and feeding systems to reduce excretory and feed wastes in aquaculture. *Aquaculture Research,* 32: 349.360.

6. Grayton, B. D. and Beamish, F. W. H. 1977. Effects of feeding frequency on food intake, growth and body composition of rainbow trout (*Salmo gairdneri*). *Aquaculture,* 11: 159-172.

7. Guinea, J. and F. Femandez. 1997. Effect of feeding frequency, feeding level and temperature on energy metabolism in *Sparus aurata. Aquaculture,*148: 125-142.

8. Hung, L. T., Anh, T. N. and Lazard, J. 1998. Effect of frequency and period of feeding on growth and feed utilization in two Asian catfishes, *Pangasius bocurti* (Sauvage, 1980) and 9. *Pangasius hypophthalmus* (Sauvage, 1987). In: M. Legendre and A. Pariselle, ed. The biological diversity and aquaculture of clariid and pangasiid catfishI In South-east Asia. *Proceedings of the midterm workshop of the 'Catfish Asia Project.*

9. Jobling, M. 1982. Some observations on the effects of feeding frequency on the food intake and growth of plaice, *Pleuronectes platessa* L. *J. Fish Biol*., 20: 431- 444.

10. Khan .S, Hossain, M. S, and Haque .M. M, 2009, Effects of feeding schedule on growth, production and economics of pangasiid catfish (*Pangasius hypophthalmus*) and silver carp *(Hypophthalmichthys molitrix*) polyculture, *J. Bangladesh Agril*. Univ. 7(1): 175–181.

11. Kader, M. A**.,** Hossain, M. A. and Hossain, M.D. 2003. A comparative study on the effect of three commercial fish feeds on the growth of Thai pangas, *Pangasius hypophthalmus*. *Bangladesh J. Fish. Res.,* 7 (2): 53-58.

12. Liu**,** F. G. and Liao, C. I. 1999. Effect of feeding regime on the food consumption, growth and body composition in hybrid striped bass *Morone saxitilis* × *M. chrysops*. *Fish. Sci*., 64: 513-519.

13. Mandal Amit, Das S.K, 2014, Comparative evaluation of two iso-nutritional feeds (mash and pellet) upon the environmental health and growth potential of two Indian major carps (Rohu, *Labeo rohita;* Mrigal, *Cirrhinus mrigala*) under mixed culture condition *IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)* e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 7, Issue 6 Ver. I (Jun. 2), PP 01-08

14. Nandeesha M. C., Gangadhara B., Manissery J.K. 2002.Further studies on the use of mixed feeding schedules withplant- and animal based diets for common carp *Cyprinus car-pio* (Linnaeus). *Aquaculture Research,* 33: 1157.1162.

15. Nandeesha M. C., Silva S.S. De, Krishna M.D. 1993. Evaluationof mixed feeding schedules in two Indian major carps,catla (*Catla catla*) and rohu (*Labeo rohita*). Pp. 753.765.*In*: Kaushik S.J., Luquet P. (eds.) Fish nutrition in practice.INRA Editions, Paris, France.

16. Nandeesha M. C., Silva S. S. De, Krishna M.D. 1995. Use of mixed feeding schedules in fish culture: performance of common carp, *Cyprinus carpio* L., on plant and animal based diets. Aquaculture Research 26: 161.166.

17. Nandeesha M. C., Silva S.S. De, Krishna M.D., Dathatri K. 1994. Use of mixed feeding schedules in fish culture. I. Field trials on catla, *Catla catla* (Hamilton-Buchanan) rohu, *Labeo rohita* (Hamilton) and common carp, *Cyprinus carpio.*

18. Patel A. B., Yakupitiyage A. 2003. Mixed feeding schedules in semi-intensive pond culture of Nile tilapia, *Oreochromis ni-loticus*, L.: Is it necessary to have two diets of differing protein contents? *Aquaculture Research,* 34: 1343.1352.

19. Sevgili H., Emre Y., Kanyilmaz M., Diler I., Hossu B. 2006. Effects of mixed feeding schedules on growth performance, body composition, and nitrogen- and phosphorus balance in rainbow trout, *Oncorhyn- chus mykiss*. *Acta Ichthyol. Piscat.* 36 (1): 49.55.

20. Yamamoto, T., Shima, T., Furuita, H., Sugita, T. and N. Suzuki. 2007, Effects of feeding time, water temperature, feeding frequency and dietary composition on apparent nutrient digestibility in rainbow trout *ncorhynchus mykiss* and common carp *Cyprinus carpio. Fisheries Science*, 73: 161 –170.