Univ. j. zool. Rajshahi Univ. Vol. 26, 2007. pp. 77-80 ISSN 1023-6104
http://journals.sfu.ca/bd/index.php/UJZRU

Effect of inorganic fertilizer on the fish growth and production in polyculture system of Bangladesh

M.A. Sayeed[1], M.T. Alam[2], S. Sultana[3], M.S. Ali[3], M.S. Azad[3] and M.A. Islam[3]
[1]Department of Fisheries Biology and Genetics, Bangladesh Agricultural University, Mymensingh;
[2]Institute of Biological Sciences, University of Rajshahi, Rajshahi;
[3]Department of Fisheries, Matshya Bhaban, Ramna, Dhaka

Abstract: A study was carried out on the optimal dose of inorganic fertilizer used in carp polyculture system over a period of 10 months. Three treatments were assigned: without inorganic fertilizer, with the application of 100 kg/ha/month inorganic fertilizer and 150 kg/ha/month inorganic fertilizer as T1, T2 and T3, respectively. Each treatment had three replications. The selected indigenous carp species were Rui (Labeo rohita), Catla (Catla catla) and Mrigal (Cirrhinus mrigala), and exotic carp species were silver carp (Hypophthalamichthys molitrix), grass carp (Ctenopharyngodon idella), common carp (Cyprinus carpio) and thai sarpunti (Barbodes gonionotus). The average water area of the experimental ponds was 0.11± 0.01 ha and average depth of water in all ponds was 1.26 m. The treatments showed no effect on water temperature, dissolved oxygen, alkalinity and pH. The fish production was significantly higher (P>0.05) in both the treatments T2 and T3 than that of T1 where no inorganic fertilizer was used. But there was no significant difference between T2 and T3 and T2 was with lower dose inorganic fertilizer (100 kg/ha/month) than T3. Therefore, 100 kg/ha/month inorganic fertilizers may be suggested in carp polyculture system for better production.

Key words: Inorganic fertilizer, optimal dose, Polyculture, Fish production.

Introduction

Fish production can be increased with accurate application of fertilizers and supplementary feeds in carp polyculture system. The main purpose of pond fertilization is to augment the production of plankton which serves as natural food of the fishes; because fertilization stimulates both the autotrophic and heterotrophic levels which increase fish production (Grag and Bhatnagar, 2000). Fish production can be increased up to 5,000 kg/ha by feeding and fertilization (Ekram, 2002). The concept of carp polyculture rests on the idea that when compatible species of different feeding habits are cultured in the same ponds, the maximum utilization of all the fish food of different column of the ponds is established. Though fertilization of ponds has been identified as an indispensable management practice for optimizing fish production, the farmers are using fertilizer in different doses which may sometimes be three or four times higher than the standard dose, hoping more benefit. However, presently crisis of the chemical fertilizer in the country is an acute problem. Moreover, the farmers are facing financial loss for buying excess fertilizer. So far, there has been little works to determine the optimum dose of fertilization needed for maximum fish production in carp polyculture. Therefore, it is important to undertake researches to find the optimal dose of inorganic fertilizer for higher fish production, lower production cost and to ensure sound environment in carp polyculture. Considering the above scenario, the present study was carried out to determine the optimal dose of inorganic fertilizer used in carp polyculture.

Materials and methods

The experiment was undertaken in Patulipara village at Bhangura upazilla under Pabna district from June 2005 to March 2006. Nine ponds were taken for three treatments each with three replicates. The average area of the ponds was 0.11± 0.01 ha. (Mean± SE). The experimental ponds were designated as T_1: T_1R_1 -T_1R_3 with supplementary feed at the rate of 2.5- 8% body weight daily and cow dung at the rate of 2,000 kg/ha/month, T_2: T_2R_1 - T_2R_3 with same feed and organic manure plus 100 kg urea and T.S.P/ha/month in the same ratio and T_3: T_3R_1-T_3R_3 in addition of same supplementary feed and organic fertilizer 150 kg urea and T.S.P./ha/month in the same ratio was used (each fertilizer was used in every alternative weeks).

The ponds were prepared by repairing the dikes and drying pond bottom in the sunlight for a week and liming at a rate of 250 kg/ha. When water increased by rainfall up to 0.61-0.91 meter, water colour became lighter, then cow-dung and inorganic fertilizer were applied at two days interval. After five days all the ponds were stocked at the rate of 6,000 fry/ha with a composition of 30% silver carp, 10% catla, 20% rui, 25% mrigal, 10% grass carp and 5% carpio. In addition 2,000 fry/ha Thai sarpunti were also stocked (Table 1). The average size of the fry was 10-14 cm except carpio and Thai punti which were 5-7 cm in size. The stocked

fry were fed daily with a mixture of fine rice bran, wheat bran and mustard oil cake at the ratio of 1:1:1 from the second day. Supplementary feed was applied at a rate of 8% body weight of the fry up to 15 days beginning from the first day, then 5% up to two months and finally 2.5% of the body weight until the fish harvest.

Table 1. Stocking density of fish species

Fish species	Average Initial wt(g)	Stocking ratio (%)	No. of fish ha^{-1}
Silver carp	47.62	30	1800
Catla	35.71	10	600
Rui	32.26	20	1200
Mrigal	37.04	25	1500
Grass carp	76.92	10	600
Common carp	18.18	5	300
Thai punti	15.15	Additional	2000
	Total stocking		8000

The fishes were sampled once in a month to observe and record the growth. The water quality parameters (temperature, dissolved oxygen (DO), pH and alkalinity) of the experimental ponds were also recorded at the time of sampling.

For statistical analysis, comparison of treatment means using one-way analysis of variance (ANOVA) followed by Duncan's Multiple Range Test (DMRT) was performed to compare the different treatment means at 5% level of significance. Statistical analysis was performed using the SPSS (windows version 11.5) software package.

Results and discussion

The water quality parameters such as Temperature (^oC), pH and DO were statistically not significant (P>0.05) but alkalinity was statistically significant (P> 0.05) among the treatments. Temperature was found to decrease gradually from October (31.8^0C) to January (17^0C) (Fig.1). This trend is related to Alam *et al.* (2003) who found the same result in Raktadaha beel in Bogra. There was no variation of water temperature in different treatments except a little during February. This trend was common in winter season. Ehsan *et al.* (1996) found the highest water temperature (31.7^0C) in the month of June and the lowest (25.2^0C) in January in Chanda beel which is similar to this study. The temperature as observed in this study appeared to be suitable for fish culture which agreed with the findings of Hossain *et al.* (1997) and Wahab *et al.* (2001).

Table 2. Water quality parameters of the experimental ponds. (Mean ± SE and ranges).

Name of parameters	T_1	T_2	T_3
Temperature(^oC)	25.25 ±1.81	25.08 ±1.82	25.24 ±1.94
	17.1 – 31.70	17.4 – 31.50	17.0 – 31.80
pH	7.48 ±1.56	7.62 ± .15	7.48 ± .13
	6.8 – 8.5	7.1 – 8.7	6.8 – 8.2
DO (mg/l)	3.83 ± .12	3.83 ± .12	3.83 ± .12
	3.1 – 4.5	3.1 – 4.5	2.81 – 5.1
Alkalinity (mg/l)	129.20 ± 1.94	129.20 ±	129.20 ± 1.94
	123 - 140	1.94	121 - 151
		125 - 143	

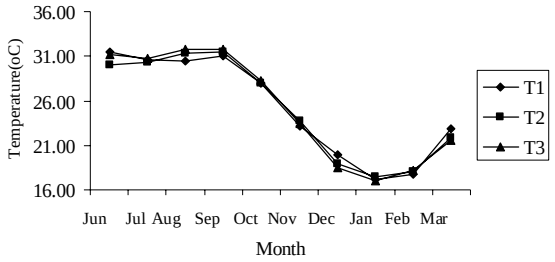

Fig. 1. Monthly variation of water temperature (°C) in different treatments

The mean pH values of different treatments were found almost neutral during the study period (Table 2), which indicates good productivity of the experimental ponds (Azim *et al.*,1995; Wahab *et al.*, 2001). The highest pH value (8.7) was recorded in August and lowest (6.8) in January in the present study (Fig. 2). The low pH values were recorded during winter possibly due to low water temperature.

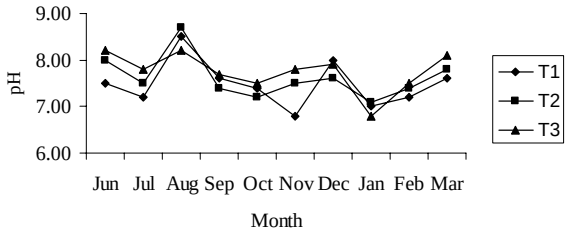

Fig. 2. Variation of pH value in different treatments during the study period

Highest value of DO was observed in December and the lowest in August (Fig. 3). Islam *et al.* (1978) reported a similar result. Kim and Kim (1986) found that the food conversion was 1.6, the daily growth rate was 1.4 at a DO concentration of 3.5-4.0 mg/l, and the growth rate markedly decreased at concentrations below 3 mg/l.

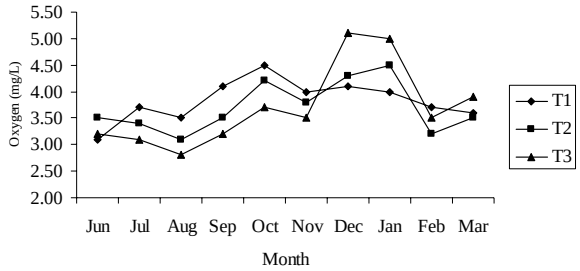

Fig. 3. Variation of dissolved oxygen (mg/l) in different treatments during the study period

Total alkalinity was found to range from 123 to 150 mg/l (Table 2, Fig. 4). Kahinoor *et al.* (2001) found the average total alkalinity above 100 mg/l in some ponds of Bangladesh Agricultural University Campus. Mazumder *et al.* (1997) recorded the total alkalinity in different water bodies in West Bengal (India) which ranged from 90 to 420 mg/l. The total alkalinity values recorded throughout the study period were within the suitable range for fish production.

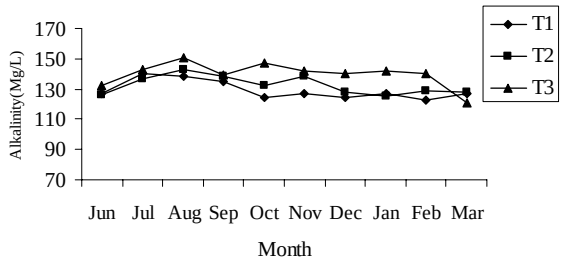

Fig. 4. Variation of Alkalinity (mg/l) in different treatments during the study period.

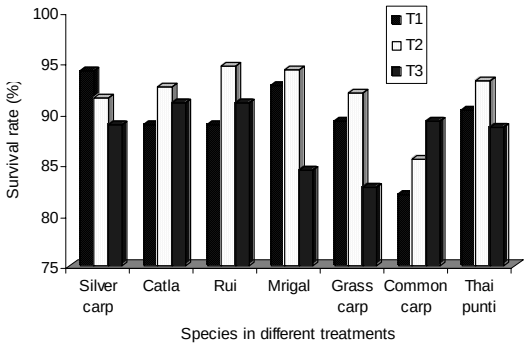

Fig. 5. Survival rates (%) of fish species in different treatments.

The average survival rate of different species was found satisfactory and comparatively higher in T_2 (Fig. 5). Highest (94.24%) survival rate of silver carp was in T_1 and lowest (88.90%) was in T_3. Highest (89.30%) survival rate of common carp was in T_3 and lowest in T_1. Highest survival rate of catla (92.59%), rui (94.72.%), mrigal (94.36%), grass carp (92.04%) and Thai punti (93.21%) were in T_2, of which, the lowest values were 88.90%, 88.83%, 84.45%, 82.78%, 88.62% in T_1, T_1, T_3, T_3, T_3 respectively. However, survival in this study was better than the result reported by Shaha *et al.* (1988).

The gross production (GP) were 2,770.49 ±315.31, 3898.34 ± 74.28 and 3981.55 kg ha^{-1} whereas net production (NP) were 2592.09 ±306.46, 3318.61 ± 65.12 and 3450.40 ± 189.41 kg/ha in 10 months in T_1, T_2 and T_3 respectively, during the present investigation (Fig 6). T_2 and T_3 showed the better result and were significantly different ($P<0.05$) from T_1. There was no significant difference ($P>0.05$) between T_3 and T_2. But in T_2 the inorganic fertilizer dose was lower than that of T_3. So, inorganic fertilizer dose in T_2 (100 kg/ha/month) is better than T_3 and can be recommended in carp polyculture. Miah *et al.* (1997) obtained 3,434.07 kg/ha fish in 10 month by applying cow dung, supplementary feed and 50 kg/ha inorganic fertilizer in carp polyculture system.

In traditional polyculture system of carps in Bangladesh the production range was 3,119 to 4067 kg/ha/yr (Uddin *et al.* 1994, Hossain *et al.* 1997 and Mazid *et al.* 1997). Awal *et al.* (1995) stated that a net production of native, exotic and mixed polyculture system were 1196, 1617 and 982 kg/ha per 6 months, respectively. Though the level of fish production in the present study was not similar to the result quoted above, but the production obtained in ten months was encouraging in terms of maximum individual weights attained.

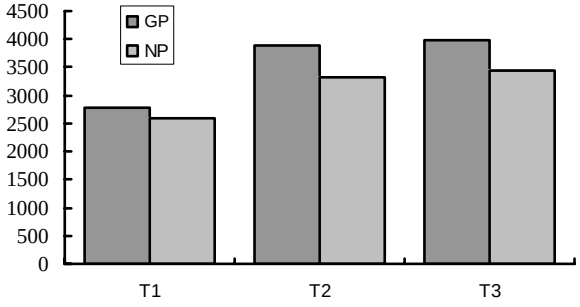

Fig. 6 Gross and net production of fish in different treatments during the study period

Conclusion

It is observed that carp polyculture using inorganic fertilizer in Bangladesh is a widely used practice of fish production whereas the actual dose of inorganic fertilizer for optimum production of natural feeds are still in the darken condition. Therefore, the production of aquaculture in a unit area is poor comparing to other neighboring countries. Moreover, farmers do not have

enough money to invest in this sector. For maximum yield in a polyculture system with comparatively low cost, the optimal dose of inorganic fertilizer used here in treatment T_2 (100 kg/ha/month) can be recommended in pond polyculture.

Reference:

Alam, M.Z., Ahmed, G.U., Alam, M.S. and Alam, M.T. 2003. Studies on fish diseases and limnological factors in Roktadaha beel, Bogra.*J. bio-sci*. **11**: 93-98.

Awal, S., Wahab, M.A., Ahmed G.U., Rahman, M.M. and Ahmed, F. 1995. Economics of different polyculture system involving native and exotic carp. *Bangladesh J. Fish*. **15-18** (1-2): 37-43.

Azim, M.E., Talukder, G.S., Wahab, M.A., Haque, M.M and Haq. M.S. 1995. Effect of liming and maintenance of total hardness levels on fish production in fertilized ponds. *Progress. Agric*. **6**(2): 7-14.

Ehshan, M.A., Hossain, M.S., Mazid, M.A., Mollah, M.F.A., Rahaman, S. and Razzaque, A. 1997. Limnology of Chanda Beel. *Bangladesh J. Fish. Res.* **1**(1): 31-40.

Ekram (2002). *The Potential of Periphyton-based Aquaculture Systems*. An unpublished Ph.D Dissertation, Wegenin Univ. Netherland 72 p.

Grag, S.K. and Bhatnagar, A. 2000. Effect of fertilization frequency on pond productivity and fish biomass in still water ponds stocked with *Cirrhinus mrigala* (Ham.). *Aquac. Res.* **31**: 409-414.

Hossain, M.A., Toyub, M.A., Islam M.N. and Hasan, M.R. 1997. Effect of species combination on the growth of major and Chinese carps in demonstration pond under Feni district. *Bngladesh Agril. Sci*. **21**(2): 257-266.

Islam, M.A., Chowdhury, M.B. and Karim, R. 1978. A comparative study of some physico-chemical factors and the growth of major carps on pond. *Bangladesh J. Aquacult*. **1**: 61-73.

Kim, I.B. and Kim, P.K. 1986. Optimum dissolved oxygen level for the growth of Israeli strain of common carp. (*Cyprinus carpio*) in the recirculating water system. *Bull. Korean Fiah. Soc*. **19**: 581-585.

Kohinoor, A.H.M., Wahab, M.A., Islam, M.L. and Thilsted, S.H. 2001. Culture potential of mola (*Amblypharyngodon mola*), chela (*Chela cachius*) and punti (*Puntius sophore*) under monoculture system. *Bangladesh J. Fish. Res*. **5**(2): 123-134.

Mazid, M.A., Zaher, M., Begum, N.N., Ali, M. Z. and Nahar, F. 1997. Formulation of cost effective feeds from locally available ingredients for carp polyculture system for increased production. *Aquaculture* **151**: 71-78.

Mazumder, S., Sengupta, A., Pati, K., Sengupta, K.K. and Santra, S.C. 1997. Water quality, plankton and periphyton assessment in different water bodies in West Bengal (India). In: *Changing perspectives of inland fisheries. Proceeding of the national seminar*, March 16-17 (eds. K.K. Vass and M. Sinha), IFSI, Barrackpore, India 187-190 pp.

Miah, M.S., Shahab Uddin, M. and Shah, M.S. 1997. Effect of stocking ratio on the growth and production of fishes in mixed polyculture system. *Bangladesh J. Fish*. **20**(1-2): 135-138.

Saha, S.B., Gupta, M.V., Hossain, M.G and Shaha, M.S. 1988. Growth and survival of rohu (*Labeo rohita*) fry in rearing ponds at different stocking densities. *Bangladesh J. Fish*. **16**(2): 119-126.

Uddin, M.S., Miah, M.S. and Alam, M.S. 1994. Study on production optimisation through polyculture of indigenous and exotic carps. *Bangladesh J. Train. Dev*. **7**(2): 67-72.

Wahab, M.A., Axim, M.E., Mahmud, A.A., Kohinoor, A.H.M. and Haque M.M. 2001. Optimisation of stocking density of Thai silver barb (*Barbodes gonionotus*) in the duckweed fed four species polyculture system. *Bangladesh J. Fish. Res*. **5**(1): 13-21.

Manuscript received on 19.11.07, accepted on 15.01.08