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EFFECTS OF INORGANIC FERTILIZERS ON THE GROWTH AND PRODUCTION PERFORMANCE OF EXOTIC CARPS IN POLYCULTURE SYSTEM

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ABSTRACT

The present study was conducted to evaluate the effects of inorganic fertilizers in combination with constant supply of supplementary feeds on growth and production of exotic carps for a period of one year, from February 2007 to January 2008. Three treatments namely T_1 {Urea + TSP (2 : 1), 40 kg/ha}, T_2 {Urea + TSP (2 : 1), 60 kg/ha} and T_3 (Urea + TSP (2 : 1), 80 kg/ha}, each in triplicates were used in the present study. Fertilizers were applied over the ponds fortnightly. The fishes were stocked @ 10,000 fry/ha with a combination ratio of 4 silver carp, 3 common carp and 3 grass carp. A mixture of supplementary feeds composed of rice bran, wheat bran and fish meal (40 : 40 : 20) were provided in all the treatments @ 5% body weight of fish twice daily. The average length (cm) and weight (g) gain were the highest in silver carp (32.3 ± 0.05 cm and 591 ± 1.37g) in treatment T_3 and the lowest in grass carp (24.5 ± 0.05 cm and 509.5 ± 0.92 g) in treatment T_1. The highest survival rate (%) was incased for silver carp (81.25%) in treatment T_3 and the lowest in grass carp (66.67%) in treatment T_1. The maximum production of all the fishes was recorded in treatment T_3 (1920, 1304 and 1164 kg/ha/year respectively), followed by the treatments T_2 (1766, 1176 and 1084 kg/ha/year respectively) and T_1 (1684, 1108 and 1022 kg/ha/year respectively). The water quality parameters such as temperature (°C), dissolved oxygen (mg/l), pH and transparency (cm), of all the experimental ponds were found within the productive range, which is suitable for fish culture.

Key words : Exotic carps, Growth, Inorganic fertilizers, Production

INTRODUCTION

Polyculture is now the most common practice of carp culture and several species combinations and stocking rate have been developed (Hoq *et al.*, 1996; Kanak, 1997). These combinations are not always considered to obtain the maximum biomass of fish from a unit area, but two or more species act as subsidiary compatible species that will utilize parts of the food resources that may be wasted otherwise (Tripathi, 1983). Exotic fishes (mainly carps) are adopted in our country for culture to obtain high production within a very short time. A wide range of exotic carps viz. common carp, bighead carp, silver carp, grass carp, black carp etc have performed better results (Akand, 1986). 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 planktons which serve as natural food of the fishes; because fertilization stimulates both the autotrophic and heterotrophic levels of natural food which increase fish production (Grag and Bhatnagar, 2000). Fish production can be increased upto 5,000 kg/ha/year 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 pond, the maximum utilization of all the fish food of different column of the pond is established. Though fertilization of ponds has been identified as an indispensable management practice for optimizing fish production, the farmers are using fertilizers of different doses which may sometimes be three or four times higher than the standard dose, hoping more benefit. However, presently crisis of the chemical fertilizers in the country is an acute problem (Ekram, 2002). Moreover, the farmers are facing financial loss for buying excess fertilizers. So far, there has been little works to determine the optimum dose of fertilization is needed for maximum fish production in carp polyculture. Therefore, it is important to undertake researches to find the optimal dose of inorganic fertilizers 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 evaluate the effects of inorganic fertilizers with constant supply of supplementary feeds on the growth, survival and production of the exotic carps in polyculture system as well as to monitor the changes of physico-chemical parameters of ponds water.

MATERIALS AND METHODS

Study area

The experiment was carried out for a period from February 2007 to January 2008 in nine mini ponds located at the south-west corner of the Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh. All these ponds were rectangular in shape, each having a surface area of 44 m^2 with an average depth of 1 m. and the ponds were without inlet and outlet.

Pond preparation

Aquatic vegetations were removed by manual methods after repairing the ponds dykes. Predatory and other unwanted species were removed by using cast and seine nets. The ponds were limed @ 250 kg/ha.

Experimental design and post-stocking management

The experiment was conducted by Completely Randomized Block Design (CRBD) process having three treatments namely T_1 {Urea + TSP (2 : 1), 40 kg/ha}, T_2 {Urea + TSP (2 : 1), 60 kg/ha} and T_3 {Urea + TSP (2 : 1), 80 kg/ha} and each treatment was run in triplicates. Stocking density was 10,000 fry/ha with a combination of silver carp (*Hypophthalmichthys molitrix*), common carp (*Cyprinus carpio*), and grass carp (*Ctenopharyngodon idella*) (4 : 3 : 3). Fishes were fed with supplementary feeds consisting of rice-bran, wheat-bran and fishmeal (40 : 40 : 20) @ 5% of their body weight throughout the study period and the fertilizers were applied over the ponds fortnightly.

Water quality parameters

The physico-chemical parameters of water of the ponds such as temperature (°C), pH, Dissolved Oxygen (DO, mg/l) and transparency (cm) was recorded monthly throughout the experimental period at 9 am by using a commercial kit box (Model : FF-3, USA).

Growth and production monitoring

Growth (length and weight) and production of fishes were measured monthly by sampling by using a measurement scale and a digital electronic balance KERN, Model No. EMB 2000-0. The following parameters were used to evaluate the growth and production of the fishes:

a) Mean length gain (cm) : Mean final length (cm) – Mean initial length (cm).
b) Mean weight gain (g) : Mean final weight (g) – Mean initial weight (g).

c) Specific growth rate, SGR (% per day) :

$$\text{SGR (\% day)} = \frac{\log W_2 - \log W_1}{T_2 - T_1} \times 100$$

Here, W_2 = Mean final weight (g), W_1 = Mean initial weight (g), T_2 = at the end of the experiment and T_1 = Initial time of the experiment

d) Survival rate (%) : $\frac{\text{No. of fish harvested}}{\text{No. of fish stocked}} \times 100$

e) Production (kg/ha/year) : No. of fish harvested × average final weight

Statistical analysis

Analysis of the data was done by the software SPSS (Statistical Package for Social Science) version 11.5 significance was assigned at 5% level.

RESULTS AND DISCUSSION

Physico-chemical parameters of water

Values of water quality parameters recorded from the experimental ponds are presented in Fig. 1. The average values of temperature (°C), (25.71 ± 1.29, 25.55 ± 1.29 and 25.78 ± 1.27), dissolved oxygen (mg/l), (5.28 ± 0.22, 5.42 ± 0.23 and 5.59 ± 0.30), pH (7.71 ± 0.15, 7.81 ± 0.16 and 7.88 ± 0.16) and transparency (cm), (29.65 ± 0.7, 29.11 ± 0.68 and 28.49 ± 0.63) were recorded in treatments T_1, T_2 and T_3, respectively. The values of water quality parameters of three treatments were not significantly ($p>0.05$) different. Hossain (2000) reported water temperature of ponds range from 26.0 to 32.4°C. Kohinoor (2000) reported more or less the same results. The temperature of ponds as observed in this study appeared to be suitable for fish culture which agreed with the findings of Hossain *et al*. (1997); Wahab *et al.* (2001). Roy (2001) considered 5.0 to 7.0 mg/l of dissolved oxygen content of water is fair or good in respect of productivity and water having dissolved oxygen less than 5 mg/l to be unproductive. Hossain (2000) found a good relationship

between pH of pond water and fish culture and obtained satisfactory results at pH 6.5 to 9.0. DoF (1998) reported that p^H 5 to 8 is good for fish culture. Nahar (1999) observed that the transparency ranged from 33.0 to 36.5 cm in the ponds. Boyd (1982) suggested that transparency from 15 to 40 cm was good for fish culture. The values of water quality parameters as recorded from the experimental ponds were well within the acceptable range for aquaculture as opined by the above authors.

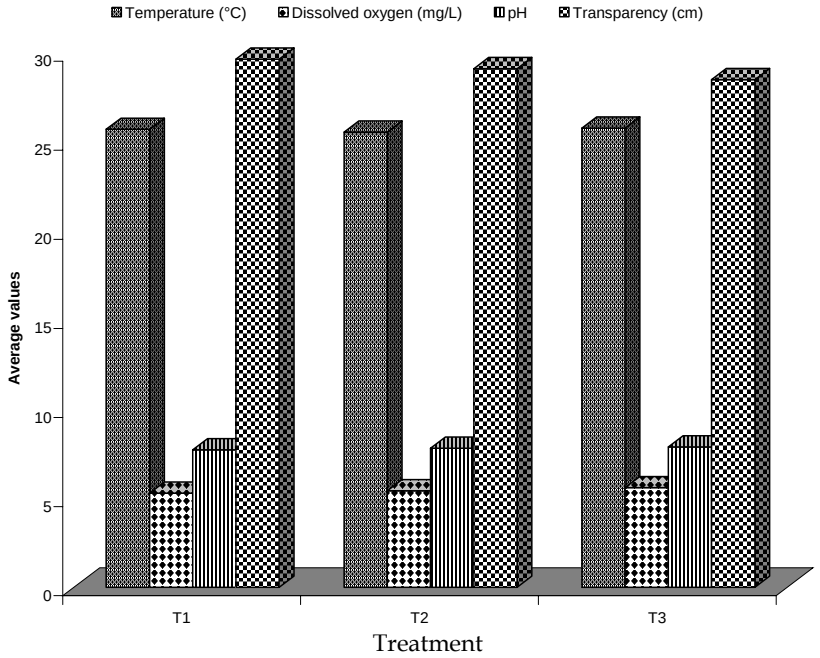

Fig. 1. Average values of water quality parameters in different treatments during the period of study

Growth performance of fishes

Growth performance of fishes (silver carp, common carp and grass carp) in terms of length (cm) and weight (g) gain, specific growth rate (% per day), survival (%) and production (kg/ ha/year) under different treatments were calculated and presented in Table 1 and 2 and Fig. 2, 3 and 4.

Length and weight gain

There was no significant ($p>0.05$) difference in initial length and weight of fishes under different treatments. The mean length (cm) and weight (g) gain of silver carp, common carp and grass carp at the end of the experiment were measured in different treatments and significantly ($p<0.05$) the highest mean length and weight gain of the fishes were obtained in treatment T_3 than those of treatments T_1 and T_2. The highest and lowest mean length gain was found in silver carp (32.3 ± 0.05) in T_3 and with grass carp (24.5 ± 0.05) in T_1, respectively. On the other hand, the highest mean weight gain was observed in silver carp (591.0 ± 1.37) in treatment T_3 and lowest was found in grass carp (509.5 ± 0.92) in T_1.

There was no significant ($p>0.05$) variation among the fishes in the same treatment in case of mean length and weight gain. From the results, it is evident that the highest mean length and weight gain were in treatment T_3, due to proper utilization of both inorganic fertilizers and supplementary feeds in all stages by the fishes and also due to good water quality conditions. The highest mean length and weight gain of silver carp were found in treatment T_3 followed by treatment T_2 and treatment T_1. This might be due to the fact that silver carp is a planktivore and it properly utilized the supplementary feeds (rice bran, wheat bran and fish meal) and natural food (phytoplankton). Mean Length gain (cm) of fishes in this present study was agreed with the findings of Saha *et al*. (1999). Weight gain (g) as observed in this study appeared to be suitable for fish culture which agreed with the findings of Miah *et al.* (1998). Kanak (1997) reported that in polyculture of exotic carps, silver carp performed the highest mean length and weight gain (30.7 cm and 513.0g).

Table 1. Mean length gain (cm), mean weight gain (g) and specific growth rate (% day) of fishes under different treatments during the study period

Treatment	Fish species	Mean initial length (cm)	Mean final length (cm) ± SE	Mean length gain (cm) ± SE	Mean initial wt. (g)	Mean final wt. (g) ± SE	Mean wt. gain (g) ± SE	SGR (% day) ± SE
T_1	Silver carp	5.5	36.1^{b}±0.07	30.6^{b}±0.07	7.0	570^{c}±0.74	563^{c}±0.74	0.523±0.02
	Common carp	5.0	30.9^{b}±0.03	25.9^{b}±0.03	6.5	540^{c}±0.74	533.5^{c}±0.74	0.526±0.02
	Grass carp	5.0	29.5^{b}±0.05	24.5^{b}±0.05	6.5	516^{c}±0.92	509.5^{c}±0.92	0.520±0.02
T_2	Silver carp	5.5	36.7^{b}±0.04	31.2^{b}±0.04	7.0	580^{b}±0.89	573^{b}±0.89	0.525±0.02
	Common carp	5.0	31.7^{b}±0.03	26.7^{b}±0.03	6.5	551^{b}±0.48	544.5^{b}±0.48	0.528±0.05
	Grass carp	5.0	30.2^{b}±0.05	25.2^{b}±0.05	6.5	528.5^{b}±0.74	522^{b}±0.74	0.523±0.02
T_3	Silver carp	5.5	37.8^{a}±0.05	32.3^{a}±0.05	7.0	598^{a}±1.37	591^{a}±1.37	0.529±0.03
	Common carp	5.0	33.0^{a}±0.05	28.0^{a}±0.05	6.5	567^{a}±0.89	560.5^{a}±0.89	0.532±0.02
	Grass carp	5.0	31.7^{a}±0.05	26.7^{a}±0.05	6.5	542.5^{a}±1.24	536^{a}±1.24	0.526±0.04

Figures with common letters in a column represent insignificant by difference and values are given ± standard error

Specific growth rate (% per day)

The mean SGR (% per day) of silver carp, common carp and grass carp in different treatments ranged between 0.520 to 0.532.The highest SGR was found in common carp (0.529) in treatment T_3 where as, the lowest was in grass carp (0.520) in treatment T_1. There was no significant ($p>0.05$) variation in SGR of fishes under different treatments. The result of the study is about same to the findings of Miah *et al*. (1998). They reported that silver carp gained the highest SGR (0.565).

Table 2. Survival (%) and production (kg/ha/year) of fishes under different treatments during the study period

Treatments	Fish species	No of fish stocked	No of fish survived	Survival (%)	Production (kg/ha/year)
T_1	Silver carp	48	36	75	1684[c]
	Common carp	36	25	69.44	1108[c]
	Grass carp	36	24	66.67	1022[c]
T_2	Silver carp	48	37	77.08	1766[b]
	Common carp	36	26	72.22	1176[b]
	Grass carp	36	25	69.44	1084[b]
T_3	Silver carp	48	39	81.25	1920[a]
	Common carp	36	28	77.78	1304[a]
	Grass carp	36	26	72.22	1164[a]

Figures with common letters in a column represent insignificant by difference and values are given ± standard error

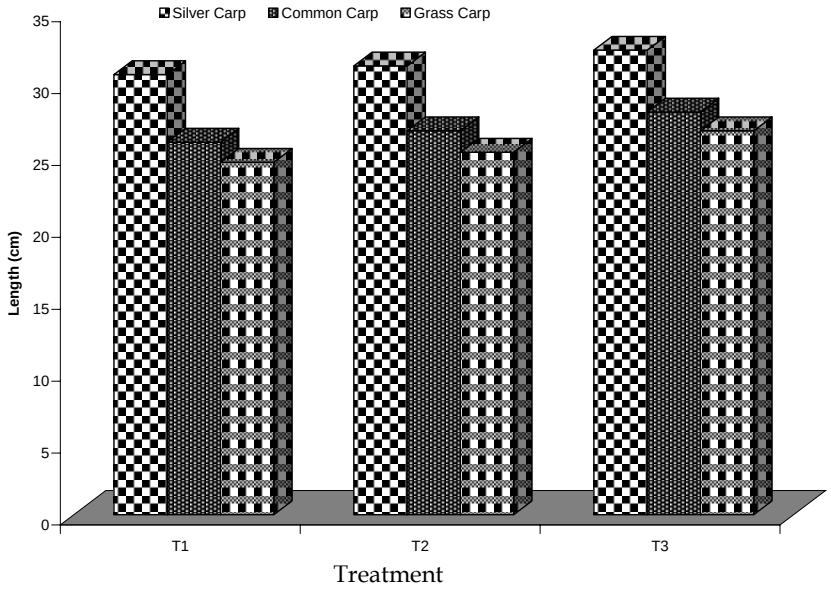

Fig. 2. Length (cm) gain of fishes in different treatments

Survival (%)

The survival (%) of silver carp, common carp and grass carp were ranged from 66.67 to 81.25 among the treatments. The highest survival (%) of the fishes was found in treatment T_3 than those of treatments T_2 and T_1. Among the treatments and fishes, highest survival (%) was obtained in silver carp (81.25%) in T_3 and there was no significant ($p>0.05$) different. Similar result also observed by Miah *et al*. (1997).

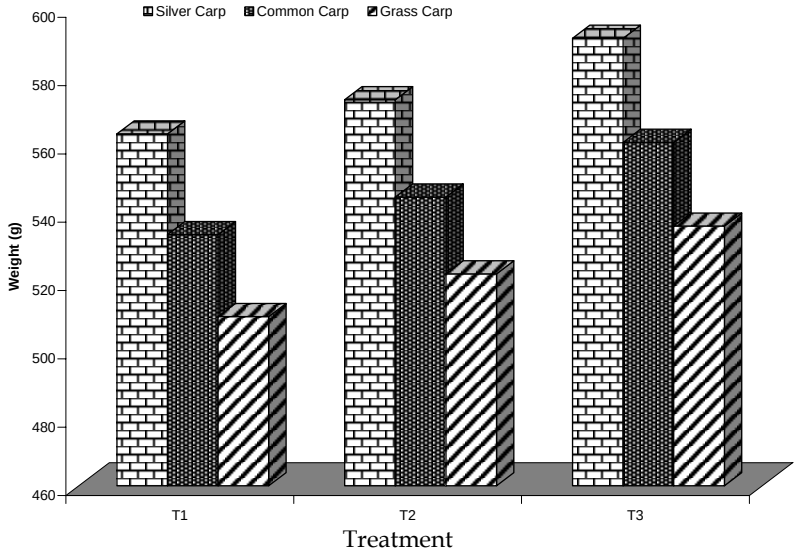

Fig. 3. Weight (g) gain of fishes in different treatments

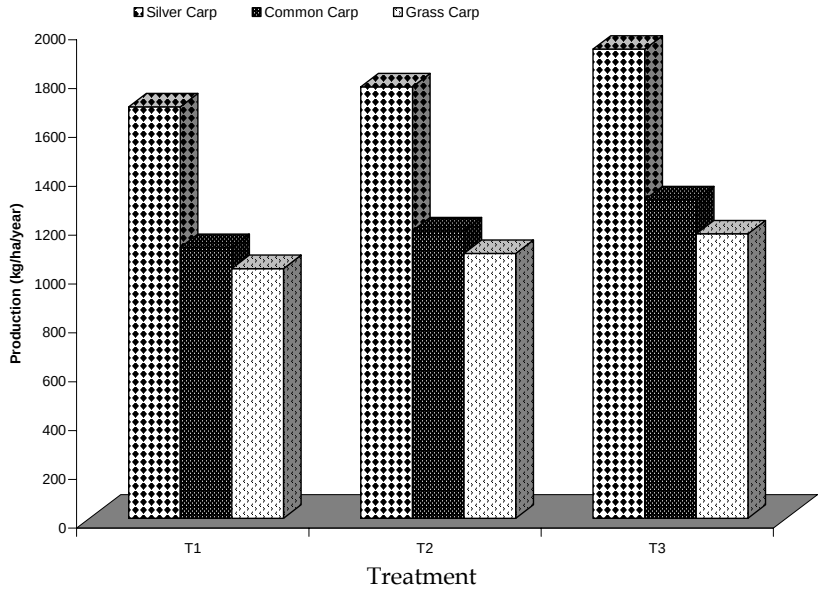

Fig. 4. Production (kg/ha/year) of fishes in different treatments during the study period

Production (kg/ha/year) of fishes

The production of silver carp, common carp and grass carp ranged between 1022 to 1920 kg/ha/year in different treatments. Treatment T_3 (1920, 1304 and 1164 kg/ha/year respectively) resulted in significantly ($p<0.05$) higher production compared to treatment T_1 (1684, 1108 and 1022 kg/ha/year respectively) and T_2 (1766, 1176 and 1084 kg/ha/year respectively). Significantly highest production was obtained in silver carp (1920

kg/ha/year) in treatment T_3 and lowest production was in grass carp (1022 kg/ha/year) in T_1. In traditional polyculturs system of carps in Bangladesh the production range was 3119 to 4067 kg/ha/year (Hossain *et al*. 1997; Mazid *et al.* 1997). Awal *et al*. (1995) stated that a net production of native, exotic and mixed carp polyculture system were 1196, 1617 and 982 kg/ha per 6 months, respectively. So, the level of fish production in the present study was more or less similar to the result quoted above.

CONCLUSION

It was observed that carp polyculture using inorganic fertilizers in Bangladesh is a widely used practice of fish production whereas the actual dose of inorganic fertilizers for optimum production of natural feed 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 (exotic carps) with comparatively low cost, the optimal dose of inorganic fertilizer (Urea and TSP) used here in treatment T_3 (80 kg/ha) can be recommended in pond polyculture.

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