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SUITABILITY OF MAHSEER *Tor putitora* (HAMILTON) IN POLYCULTURE WITH INDIAN MAJOR CARPS

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ABSTRACT

An experiment on polyculture of mahseer with Indian major carps at same stocking density was carried out for a period of 10 months from February 1 to December 1, 2004 in six experimental ponds. There were three treatments with two replicates each. Treatment 1 was designed with catla (*Catla catla*), rohu (*Labeo rohita*) and mrigal (*Cirrhinus mrigala*), treatment 2 with catla (*Catla catla*), rohu (*Labeo rohita*) and mahseer (*Tor putitora*) while treatment 3 with catla (*Catla catla*), rohu (*Labeo rohita*), mrigal (*Cirrhinus mrigala*) and mahseer (*Tor putitora*). Mahseer of the treatment 2 was introduced instead of mrigal of treatment 1 and 50% of mrigal was replaced with mahseer in treatment 3. The stocking density in all the treatments was 30 fish/decimal (7500 fish/ha). The feeds were supplied at the rate of 3-7% of the body weight of fish. The gross and net productions recorded were 5362.78 and 5188.64, 5431.42 and 5262.32, 5357.11 and 5528.74 kg/ha/yr in treatments 1, 2 and 3 respectively. Though there was no significant difference ($p>0.05$) among the three treatments using ANOVA but the production in treatment-3 was slightly higher than treatments 1 and treatment 2. However, there was no negative effect of mahseer on the growth and production of Indian major carps. So, it can be concluded that polyculture of mahseer with Indian major carps (catla, rohu and mrigal) can be done in ponds.

Key Words : Mahseer, Tor putitiora, Polyculture

INTRODUCTION

The basic principles of the polyculture of fish rests on the ideas that when compatible species of different feeding habits are cultured in the same pond, the maximum utilization of all requirements of life takes place without any harm to each other and may produce an expected production of fish with different feeding habits if stocked in proper ratios, densities and combinations (Halver, 1984). Ahmed (1992) reported that in species selection for polyculture, primary importance was given to Indian major carps such as rohu (*Labeo rohita*), catla (*Catla catla*) and mrigal (*Cirrhinus mrigala*) and sometimes calbaus (*Labeo calbasu*). In recent years, endangered fish species such as *Tor* spp. drew an attention to Bangladesh Fisheries Research Institute (BFRI) for the better growth performance under polyculture system.

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Mahseer, *T. putitora* is the inhabitant of hill-streams and widely distributed is India, Nepal, Bangladesh and Pakistan. Mahseer is an omnivore fish and its diet is consisted of insects, molluses and small fish (Pisolkar and Karamchandani, 1984). As the natural stocks of mahseer are already in danger due to genetic erosion, mahseer is being considered as a critically endangered species also in Bangladesh. To protect the fish from extinction and to conserve the natural stocks, development of technology for breeding, nursing, rearing of fry and fingerlings as well as culture technique of mahseer is essential.

The aims of the present work were to create a base for the development of aquaculture technology of the 'Golden Mahseer' (*T. putitora*) with Indian major carps in general, so that the species can be introduced into commercial aquaculture of Bangladesh. Another important aim of the present work was to protect the fish from the extinction.

MATERIALS AND METHODS

The experiment was carried out for a period of 10 months from February 1, 2004 to December 1, 2004 in 6 experimental ponds and each pond was 10 decimal with an average water depth of 5-7 feet. During the pond preparation, Lime was applied at the rate of 1 kg/decimal and the ponds were manured with cowdung at the rate of 10 kg/decimal. Seven days after liming, the ponds were fertilized each with Urea and TSP. at the rate of 100 gm/decimal.

Soon after appearance of light plankton bloom, the ponds were stocked with Indian major carp viz. catla (*Catla catla*), rohu (*Labeo rohita*) and mrigal (*Cirrhinus mrigala*) and one endangered native carp species mahseer (*Tor putitora*). Ponds were divided under three treatments having two replicates each. Species combination under treatment 1 was catla (*Catla catla*), rohu (*Labeo rohita*) and mrigal (*Cirrhinus mrigala*); that under treatment 2 was catla (*Catla catla*), rohu (*Labeo rohita*) and mahseer (*Tor putitora*); and that under treatment 3 was catla (*Catla catla*), rohu (*Labeo rohita*), mrigal (*Cirrhinus mrigala*) and mahseer (*Tor putitora*). Mahseer of the treatment 2 was introduced instead of mrigal in treatment 1 and 50% of mrigal was replaced with mahseer in treatment 3. Stocking ratios were Catla (40%), rohu (30%) and mrigal (30%) in treatment 1; catla (40%), rohu (30%) and mahseer(30%) in treatment 2 and catla (40%), rohu (30%), mrigal (15%) and mahseer (15%) were stocked in treatment 3. The above different species compositions were stocked with fish fingerlings at the rate of 30 fish per decimal (7500fish/ha). Initial mean weight of catla, rohu, mrigal and mahseer were 26.45 ± 5.20, 21.69 ± 4.36, 20.44 ± 0.35 and 18.20 ± 1.32 g respectively.

The ponds were fertilized regularly at 15 days intervals with Urea and TSP and cowdung at the rate of 200, 100 g/decimal and 7.5 kg/decimal respectively. Rice bran (50%), wheat bran (20%), mustard oil cake (MOC, 25%) and fishmeal (5%) were used as supplementary pelleted feed.

Monthly growth rate of fish such as weight gain, percentage of weight gain, specific growth rate (SGR), were properly monitored under each treatment. Water quality parameters were measured and recorded monthly throughout the experimental period.

RESULTS

Physico-chemical parameters of pond waters

Results of physical parameters such as water temperature (°C) and transparency (cm), chemical parameters such as dissolved oxygen (mg/L), pH and total alkalinity (mg/L) are shown in Table 1.

Plankton density

The plankton density in the ponds under three treatments were estimated in volumetric method and identified up to genus level (Table 2).

Table 1. Physico-chemical parameters of water of the ponds under three treatments during a period of ten months (All values represent mean ± s.d. with ranges in parentheses)

Parameters	Treatment-1	Treatment-2	Treatment-3
Temperature (°C)	28.92 ± 2.06	28.98 ± 2.08	28.90 ± 2.05
Transparency (cm)	44.85 ± 9.15	42.25 ± 7.54	42.35 ± 10.13
Dissolved oxygen (mg/L)	5.51 ± 1.17	5.25 ± 1.07	5.38 ± 1.07
pH	7.74 ± 0.32	7.65 ± 0.32	7.59 ± 0.38
Total alkalinity(mg/L)	164.30 ± 38.47	152.78 ± 23.26	160.75 ± 34.74

Table 2. Mean population density (± s.d.) of plankton (× 10^3, cells/L) of the pond water under three treatments during a period of ten months

Plankton group	Treatment-1	Treatment-2	Treatment-3
Phytoplankton			
Bacillariophyceae	8.73 ± 7.02	11.39 ± 8.23	12.52 ± 9.21
Chlorophyceae	27.81 ± 8.55	36.07 ± 8.75	32.64 ± 9.82
Cyanophyceae	14.51 ± 6.36	13.50 ± 6.45	14.54 ± 6.42
Euglenophyceae	10.31 ± 4.56	9.58 ± 4.32	8.29 ± 5.46
Total phytoplankton	61.36 ± 8.66	70.54 ± 12.39	67.99 ± 10.75
Zooplankton			
Rotifera	4.21 ± 2.64	3.84 ± 2.57	3.78 ± 2.58
Crustacea	2.68 ± 2.45	2.02 ± 2.34	1.79 ± 1.74
Total zooplankton	6.89 ± 1.08	5.86 ± 1.29	5.57 ± 1.41

Growth performance of fish

During the experimental period growth parameters such as final mean weight, weight gain and specific growth rate (%) were calculated monthly and survival rate (%) and total production have been shown in Table 3.

Table 3. Growth and production of fishes cultured under three treatments during a period of ten months

Treatments	Species	Stocking density No./ha	Initial mean wt. (g)	Final mean wt. (g)	Mean weight gain (g)	Survival rate (%)	Specific growth rate (%/day)	Production (kg/ha/yr)	
								Gross	Net
T-1	*C. catla*	3000	26.45 ± 5.20	706.40 ± 10.63[a*]	679.95 ± 10.63[a]	89.59	1.09[a]	5362.78[a]	5188.64[a]
	L. rohita	2250	21.69 ± 4.36	658.77 ± 6.33[a]	637.08 ± 6.33[a]	92.78	1.18[a]		
	C. mrigala	2250	20.44 ± 0.35	565.76 ± 6.27[a]	545.32 ± 6.27[a]	93.89	1.10[a]		
T-2	*C. catla*	3000	26.45 ± 5.20	710.23 ± 7.79[a]	683.78 ± 7.79[a]	91.25	1.09[a]	5431.42[a]	5262.32[a]
	L. rohita	2250	21.69 ± 4.36	658.90 ± 6.33[a]	637.21 ± 6.33[a]	92.22	1.13[a]		
	T. putitora	2250	18.20 ± 1.32	568.10 ± 8.60[a]	549.90 ± 8.60[a]	95.00	1.14[a]		
T-3	*C. catla*	3000	26.45 ± 5.20	717.17 ± 2.26[a]	690.72 ± 2.26[a]	92.92	1.09[a]	5528.74[a]	5357.11[a]
	L. rohita	2250	21.69 ± 4.36	662.14 ± 6.92[a]	640.45 ± 6.92[a]	92.78	1.13[a]		
	C. mrigala	1125	20.44 ± 0.35	577.45 ± 5.30[a]	562.01 ± 12.37[a]	92.22	1.10[a]		
	T. putitora	1125	18.20 ± 1.32	590.25 ± 3.57[a]	572.05 ± 3.57[a]	94.45	1.15[a]		

In case of catla, the average initial weight of 26.45 ± 5.20 g reached to a final weight of 706.40 ± 10.63 g, 710.23 ± 7.79 g and 717.17 ± 2.26 g in treatments 1, 2 and 3 respectively. The mean values of weight gain (g) of catla were 679.95 ± 10.63, 683.78 ± 7.79 and 690.72 ± 2.26 under treatments1, 2 and 3 respectively (Table 3).

In case of rohu, the average final weight of 637.08 ± 6.33 g, 637.21 ± 6.33 g and 640.45 ± 6.92 g treatments 1, 2 and 3 respectively. The mean values of weight gain (g) and SGR (%/day) of rohu were 637.08 ± 6.33, 637.21 ± 6.33 and 640.45 ± 6.92; 1.18, 1.13 and 1.13 under treatments 1, 2 and 3 respectively (Table 3).

In case of mrigal, the average initial weight of 20.44 ± 0.35 g reached to a final weight of 565.76 ± 6.27 g and 577.45 ± 5.30 g under treatments 1 and 3 respectively. The mean

values of weight gain (g) were 545.32 ± 6.27 and 562.01 ± 12.37 and SGR (%/day) were 1.10 and 1.10 under treatments 1 and 3 respectively (Table 3).

In case of mahser, average initial weight were 18.20 ± 1.32 g reached to a final weight of 568.10 ± 8.60 g and 590.25 ± 3.57 g in treatments 2 and 3 respectively. The mean values of weight gain (g) of mahseer were 549.90 ± 8.60 and 572.05 ± 3.57 and SGR (%/day) were 1.14 and 1.15 in treatments 2 and 3 respectively (Table 3).

Survival rate (%)

The survival rate of fishes of each species for each treatment was estimated separately and the values so far recorded are presented in Table 3. The survival rates (%) of different fish species in different treatments were fairly high. The survival rates of all treatments of all species were more or less similar (89.59 - 95.00%).

Production of fish

Details of stocking, harvesting, survival rate and total (gross and net) production of fish species under three treatments have been shown in Table 3.

Table 4. ANOVA of gross fish productions of the ponds under three treatments each having 2 replications

	Degrees of freedom (DF)	Sum of squares (SS)	Mean squares (MS)	F-value
Between treatments	2	27815.169	13907.585	0.877 NS
Within treatments	3	47598.187	15866.062	-
Total	5	75413.357	-	-

NS = non significant (p>0.05)

Table 5. ANOVA of net fish productions of the ponds under three treatments each having 2 replications

	Degrees of freedom (DF)	Sum of squares (SS)	Mean squares (MS)	F-value
Between treatments	2	28528.877	14264.438	0.899 NS
Within treatments	3	47598.034	15866.011	-
Total	5	76126.910	-	-

NS = non significant (p>0.05)

The gross and net productions recorded in treatment 1 were 5362.78 and 5188.64 kg/ha/yr where species combination were catla, rohu and mrigal; in treatment 2 were 5431.42 and 5262.32 kg/ha/yr where species combination were catla, rohu and mahseer and in treatment 3 were 5528.74 and 5357.11 kg/ha/yr where species combination were catla, rohu, mrigal and mahseer (Table 3).

DISCUSSION

Physico-chemical parameters of pond water

Throughout the experimental period the temperature was within the acceptable range for fish culture. According to Aminul (1996), water temperature 25 to 35°C is suitable for fish culture. In the present study, the highest temperature (31.5°C) recorded during the month of September was in treatment 1 due to relatively high intensity of sunlight and absence of cloud in the sky and the lowest 25°C was found in December in treatment-3 might be due to low intensity of light and cool weather.

The mean values of water transparency were 44.85 ± 9.15, 42.25 ± 7.54 and 42.35 ± 10.13 cm in treatments 1, 2 and 3 respectively and ranged from 31 to 62 cm which were near to the findings of Kohinoor (2000) who recorded transparency values ranging from 15 to 58 cm. Wahab *et al.* (1994) found transparency depth ranging from 15-75 cm in polyculture pond.

The dissolved oxygen values during the experimental period were found to be within the productive range according to the statements of Jhingran, 1991; Wahab *et al.,* 1996.

According to Swingle (1967) pH 6.5 to 9.0 is suitable for pond fish culture and in the present study, the values of pH was similar to these values. According to Alikunhi (1957) total alkalinity more than 100 mg/L should be present in highly productive water bodies. During the present study monthly variations of total alkalinity in the experimental ponds ranged from 95-225 mg/L which was more or less similar to the results of Haque (1996); Paul (1998); Kohinoor (2000).

Plankton

In the present study, the mean values of phytoplankton of the experimental ponds were 61.36 ± 8.66 x 10^3 cells/L, 70.54 ± 12.39 x 10^3 cells/L and 67.99 ± 10.75 x 10^3 cells/L and those of zooplankton were 6.89 ± 1.08 x 10^3 cells/L, 5.86 ± 1.29 x 10^3 cells/L and 5.57 ± 1.41 x 10^3 cells/L in treatments 1, 2 and 3, respectively. Paul (1998) found phytoplankton densities of 53.41 to 68.37 × 10^3 cells/L and that of zooplankton of 3.83 to 3.22 × 10^3 cells/L which were more or less similar to those of the present study. But Wahab *et al.* (1994) recorded phytoplankton numbers ranging from 2 to 8×10^5/L and zooplankton 2 to 3.2 × 10^4/L, Kohinoor (1998) found the density of phytoplankton as 21.67 × 10^4 cells/L and that of zooplankton as 5.2 × 10^4 cells/L which were higher than that of the present study. This might be due to the fact that the rate of fertilization used by Wahab and Kohinoor was higher than those used in the present study. Besides, during the present study comparatively less amount of organic fertilizer was used.

Growth and production of fish

During the period of study the mean weight gain (g/fish) of rohu, catla and mrigal were 637.08 ± 6.33, 679.95 ± 10.63 and 545.32 ± 6.27 g in treatment 1; those of rohu, catla and mahseer were 637.21 ± 6.33, 683.78 ± 7.79 and 549.90 ± 8.60 g in treatment 2 and those of

rohu, catla, mrigal and mahseer were 640.45 ± 6.92, 690.72 ± 2.26, 562.01 ± 12.37 and 572.05 ± 3.57 g in treatment 3 respectively. It was observed that weight gain (g/fish) of rohu and catla was more or less similar in all the three treatments; weight gain (g/fish) of mrigal was more or less same in treatment 1 and 3. On the other hand weight gain (g/fish) of mahseer was slightly higher in treatment 3 but not significantly different ($p>0.05$) from treatment 2. From the results, it is evident that the growth of rohu, catla and mrigal were not affected when cultured with mahseer.

In the present study, the SGR (%/day) of rohu, catla and mrigal were 1.18, 1.09 and 1.10; that of rohu, catla and mahseer were 1.13, 1.09 and 1.14 and that of rohu, catla, mrigal and mahseer were 1.13, 1.09, 1.10 and 1.15 in treatments 1, 2 and 3 respectively. Bandari (1998) reported that SGR (%/day) of rohu, catla and mrigal were 2.40, 3.00 and 2.56 which are not in agreement with the present study.

The calculated gross and net productions obtained in the present study were 5362.78 and 5188.64 kg/ha/yr, 5431.42 and 5262.32 kg/ha/yr and 5528.74 and 5357.11 kg/ha/yr in treatments 1, 2 and 3 respectively. The reason behind the highest production in treatment 3 might be due to replacement of mrigal (50%) with mahseer (50%) and proper utilization of supplemental and natural food especially phytoplankton and zooplankton. The another reason might be the value of individual final weight were found to be averagely higher and better species combination in the treatment 3 than the rest of two treatments. Mathew *et al.* (1988); Gupta *et al.* (1990) also reported good results from the polyculture of Indian major carps with Chinese carps and the yield recorded by them were 7000-9000 kg/ha/yr, 7444.8 kg/ha/yr, 10183 kg/ha/yr and 4917 kg/ha/yr respectively. Mazid *et al.* (1997) found a gross production of 3,600 kg/ha/yr from composite culture of Indian major carps and Chinese carps in Bangladesh. The total productions of fish of the present experiment were within the range of good production in comparison with the productions mentioned above.

Analysis of variance (ANOVA) of gross and net productions of fish shows that difference between gross and net productions under three treatments are not statistically significant ($F = 0.877$ N.S. and $F = 0.899$ N.S.) ($p>0.05$) i.e. there is no bad effects of mahseer on the growth and production of Indian majors carps in polyculture system.

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