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Culture of *Amblypharyngodon mola* in rice fields alone and in combination with *Barbodes gonionotus* and *Cyprinus carpio*

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Abstract
A rice-fish culture experiment with four treatments *viz.*, T_1 with *Amblypharyngodon mola* alone, T_2 with *A. mola* and *Barbodes gonionotus*, T_3 with *A. mola* and *Cyprinis carpio* and T_4 as control (without fish) was carried out in the rice fields during April through August'99. The recovery rate of *A. mola* were 42%, 37% and 42% in treatments 1, 2 and 3 respectively and the same recorded for *B. gonionotus* and *C. carpio* were 62% and 55% respectively. Among the three species of fish, *B. gonionotus* showed much higher recovery rate than both of *A. mola* and *C. carpio*. The production of *A. mola* was 12.50 kg/ha/3 months in monoculture, and 7.92 kg/ha/3 months and 8.86 kg/ha/3 months in combination with *B. gonionotus* and *C. carpio*, respectively. The production of *B. gonionotus* in T_2 was 169.29 kg/ha/3 months and *C. carpio* in T_3 was 252.92 kg/ha/3 months. The total fish production was 12.50 kg/ha/3 months, 175.21 kg/ha/3 months and 261.88 kg/ha/3 months in T_1, T_2 and T_3, respectively. The highest yields of rice grain (5.78 ton/ha) and straw (7.83 ton/ha) were recorded in T_3 and the lowest of the same was in T_4 (grain 4.96 ton/ha and straw 6.62 ton/ha). Rice yield increased by about 12.10% in T_1, 13.30% in T_2 and 16.33% in T_3 in context to T_4, rice-alone culture. The results demonstrated that the culture of fish in rice fields had profound beneficial impact on the production of rice grain and straw.

Key wards: Rice-fish culture, *A. mola, B. gonionotus, C. carpio*

Introduction

Vitamin-A deficiency is one of the major causes of wide spread child blindness in Bangladesh. Sixteen small indigenous species (SIS) of fish are prescribed for small-scale culture (Felts *et al.* 1996) in rural areas. Among these *A. mola* is of special interest to fish culturists because of its high vitamin-A and other micronutrient content. *A. mola* contains 200 IU of vitamin-A per gram of edible protein (Zafri and Ahmed 1981). A medium sized *A. mola* fish has about 2.0 g of edible protein in its body, which contains about 520 IU of vitamin-A. This means that intake of only three *A. mola* daily would contribute too more than 1,500 IU of vitamin-A, which is sufficient to save a child from

blindness (BSS 1988). On the other hand, Bangladesh possess more than 2.83 million ha of seasonal paddy fields where water stands for 4-6 months, providing great scope for rice-fish culture. Fish harvested from these areas is around 37 kg/ha (MPO 1985). Fish culture in rice fields can provide adequate means of income and food for the rural people, since the production of staple grain and a high quality valuable protein can be accomplished from one system on the same piece of land (Ahmad 1956, Haroon and Alam 1992).

The potential biological advantages which *A. mola* offer is their rapid growth, several spawning in the same season and possibility to culture in the shallow stagnant water like rice fields. The present study has thus been undertaken to determine the suitability of *A. mola* culture in rice field both alone and in combination with *B. gonionotus* and *C. carpio*.

Materials and methods

The experiment was conducted in the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during April through August'99. Twelve experimental plots were randomly selected from 0.20 hectares area. Rain and deep tube-well were the sources of water supply to the experimental plots during the study period. A 0.50 meter wide embankment surrounded the experimental area and protected the plots from flooding. A 4 m^2 ditch was constructed in the middle and having a depth of about 70 cm. The plots were well ploughed, leveled and made weed free. The seedlings of rice variety BR-2 (Mala) of 45 days old were transplanted on 17th May'99 in alternative row spacing of 35 cm ± 15 cm. The plant to plant distance was 20 cm. The alternative row spacing provided enough space for easy movement of fishes. All the rice plots were identically fertilized with urea, T.S.P., MP and gypsum at the conventional rates.

After 15 days of transplanting, only *A. mola* were stocked in the T_1 at the rate of 20,000 fry/ha, *A. mola* plus *B. gonionotus* and *A. mola* plus *C. carpio* were stocked in the treatments T_2 and T_3 at the rate of 14,000 fry/ha plus 3,750 fry/ha, respectively. During the period of fish culture, water level varied between 15-30 cm. No pesticide was applied to the crop field and no supplementary feed was used for fish.

On maturity, rice was harvested on 30 August'99. The grain and straw were cleaned, sun dried to 14% moisture content and weighted plot-wise and then converted to ton/ha The fish was harvested after rice harvesting, i.e. 88 days after stocking fish fry. Number, length and weight of individual fish was counted plot-wise. All the data were analyzed statistically using Analysis of Variance (ANOVA) and the mean values were compared using Duncun's Multiple Range Test (Gomez and Gomez 1984).

Results and discussion

Growth and recovery rate of fish

During the experimental period the growth rate of *A. mola* by net (1.13 cm and 0.72 g), percentage (27.90% and 86.05%) and SGR (0.70% day) were higher in combination with *C. carpio* among the 3 treatments (Table 1). Between the rest of the two species of fish, *B. gonionotus* showed higher net increase (11.33 cm) and percentage of increase (197.85%) in length, on the contrary, *C. carpio* showed higher net increase (114.46 g), percentage of increase (1358.04%) and SGR (3.04% day) in weight might be associated with their body shape. Growth rate and specific growth rate of 3 species in length and weight are shown in Tables 2-4. The growth rate of *B. gonionotus* recorded by Hossain (1989) was 15.3 cm in length and 77.70 g in weight in his rice fish culture. Whereas, Akhteruzzaman *et al.* (1993) reported the growth rate for *B. gonionotus* and *C. carpio* were 38 g and 63 g respectively in rice fish culture. The difference between the growth rates of both the species recorded in the present study and the growth rate recorded by them might be due to stocking size, stocking density and period of culture.

The recovery rate of fish was determined from the recovery data at the end of the experiment. The recovery rate for *B. gonionotus* was almost close to the recovery rate (65% and 68%) recorded by Rahman *et al.* (1995) and Akhteruzzaman *et al.* (1993), respectively in their experiments. The recovery rate recorded for *C. carpio* in the present study is the conformity with the same (53%) recorded by Akhteruzzaman *et al.* (1993).

Production of fish

In treatment T_1, by stocking 0.90 kg of *A. mola*, only 0.6 kg of *A. mola* was produced and loss of about 0.3 kg. In treatment T_2 stocking 0.59 kg, produced only 0.38 kg of *A. mola*. While 8.03 kg of *B. gonionotus* was produced by stocking only 0.97 kg and in treatment T_3 0.43 kg of *A. mola* was produced by stocking 0.55 kg while 12.14 kg of *C. carpio* was produced by stocking 1.54 kg fry.

It was observed that production of *A. mola* was very low compared to the production, 1,750 kg/ha/year and 58.57 kg/ha/4 month recorded by Ameen *et al.* (1984) and Islam (1997), respectively. At the end of the experiment when all the fishes were harvested most of the *A. mola* were small and they could easily hide in the rice field clay. So, they were not easily harvestable. But the adult *A. mola* could be harvested easily.

The production of *B. gonionotus* in rice field recorded by Khan *et al.* (1997) was 229.22 kg/ha, which was much higher than that of the present study (169.29 kg/ha). This might be attributed to stocking size and recovery rate. The production of *B. gonionotus* obtained by MCC (1994) and Akhteruzzaman *et al.* (1993) was similar to the production recorded in the present study. Khan *et al.* (1997) obtained a production of 233.49 kg/ha of *C. carpio* in rice fish culture, which is quite close to the production recorded in the present study. So production of *B. gonionotus* and *C. carpio* is acceptable in rice fish

Table 1. Details of stocking, harvesting and production of fish under different treatments in the rice fields

Treatments	Fish species	At stocking			At harvesting			Recovery rate (%)	Production (kg/ha)	
		Average initial wt (g)	Total no. of fish	Total wt. of fish (kg)	Average final wt. (g)	Total no. of fish recaptured	Total wt. of fish (g)			Total
T_1	*Amblypharyngodon mola*	0.94±0.01	960	0.90	1.50±0.01	403	0.60	42	12.5	12.5
T_2	*Amblypharyngodon mola*	0.90±0.04	660	0.59	1.55±0.03	244	0.38	37	7.92	175.21
	Barbodes gonionotus	5.37±0.42	180	0.97	71.66±2.02	112	8.03	62	167.29	
T_3	*Amblypharyngodon mola*	0.83±0.01	660	0.55	1.55±0.03	277	0.43	42	8.96	261.88
	Cyprinus carpio	8.54±0.85	180	1.54	122.67±4.8	99	12.14	55	252.92	

culture and there was no negative impact was found on growth and production of *B. gonionotus* and *C. carpio* due to introduction of *A. mola* in rice fields. Kohinoor *et al.* (1998) found that *A. mola* exerted a negative impact on growth and production of carps in polyculture system.

Table 2. Growth rate and specific growth rate of *B. gonionotus* by average in length and weight

Parameters	Treatment	Replication	Initial	Final	Net increase	% increase	SGR (% day)
Length (cm)	T_2	R_1	6.8	17.5	10.7	157.35	
		R_2	5.6	17.0	11.8	210.71	
		R_3	5.1	16.6	11.5	225.49	
	Mean ± S.E		5.83 ±0.50	17.03 ±0.26	11.33 ±0.33	197.85 ±20.69	
Weight (g)	T_2	R_1	6.2	75	68.8	1109.67	2.83
		R_2	4.9	72	67.1	1239.38	2.83
		R_3	5.0	68	63	1260.00	2.97
	Mean ± S.E		5.37 ±0.42	71.66 ±2.03	66.3 ±1.72	1246.35 ±75.28	2.87 ±0.04

Table 3. Growth rate and specific growth rate of *C. carpio* by average in length and weight

Parameters	Treatment	Replication	Initial	Final	Net increase	% increase	SGR (% day)
Length (cm)	T_3	R_1	9.5	22	12.5	131.58	
		R_2	8.2	18	9.8	119.51	
		R_3	8.5	18	9.5	117.76	
	Mean ± S.E		8.73 ±0.39	19.33 ±1.33	10.6 ±0.95	120.95 ±5.77	
Weight (g)	T_3	R_1	10.2	132	122.8	1203.92	2.91
		R_2	7.39	120	112.6	1523.81	3.17
		R_3	8.02	116	107.98	1345.38	3.04
	Mean ± S.E		8.54 ±0.85	122.67 ±4.8	114.46 ±4.38	1358.04 ±92.53	3.04 ±0.07

Table 4. Growth rate and specific growth rate of *A. mola* by average in length and weight

Parameters	Treat ment	Replication	Initial	Final	Net increase	% increase	SGR (% day)
Length	T_1	R_1	4.6	5.0	0.4	8.7	
(cm)		R_2	5.0	5.3	0.3	6	
		R_3	4.7	5.4	0.7	14.9	
	Mean ± S.E		4.77±0.01	5.23±0.12	0.5±0.12	9.87±2.63	
Weight	T_1	R_1	0.94	1.49	0.55	58.81	0.52
(g)		R_2	0.92	1.47	0.55	59.78	0.53
		R_3	0.96	1.53	0.57	59.38	0.53
	Mean ± S.E		0.94±0.01	1.50±0.01	0.56±0.01	59.32±0.28	0.53±0.003
Length	T_2	R_1	4.1	5.2	1.1	26.82	
(cm)		R_2	4.2	5.4	1.2	28.60	
		R_3	4.6	5.2	0.6	13.04	
	Mean ± S.E		4.3±0.15	5.3±0.07	0.96±0.19	22.81±4.91	
Weight	T_2	R_1	0.85	1.53	0.68	80.00	0.56
(g)		R_2	0.87	1.62	0.75	86.20	0.71
		R_3	0.97	1.49	0.52	53.60	0.49
	Mean ± S.E		0.90±0.4	1.55±0.03	0.65±0.06	73.20±9.95	0.59±0.06
Length	T_3	R_1	4.0	5.1	1.1	27.50	
(cm)		R_2	4.1	5.2	1.1	26.19	
		R_3	4.0	5.2	1.2	30.00	
	Mean ± S.E		4.03±0.03	5.2±0.03	1.13±0.03	27.90±1.12	
Weight	T_3	R_1	0.83	1.50	0.67	80.72	0.67
(g)		R_2	0.85	1.56	0.71	83.52	0.69
		R_3	0.82	1.59	0.77	93.90	0.75
	Mean ± S.E		0.83±0.01	1.55±0.03	0.72±0.03	86.05±4.00	0.70±0.02

Production of rice grain and straw

Among the four treatments, the highest production of rice grain and straw were recorded in T_3, where *A. mola* was cultured with *C. carpio,* which is closely followed by the production in T_2 and T_1. The production of grain ranged from 4.96 to 5.77 ton/ha. Khan *et al.* (1997) found that the production range of rice grain in rice fish plots was 6.03 to 6.16 ton/ha. In the present study, production of rice grain and straw obtained in the treatments with fish and without fish were found to differ significantly ($P<0.01$). On the basis of production of rice grain, no statistical significant difference ($P>0.01$) was found among the three treatments with fish. The production of grain obtained by Gupta and Mazid (1993) and Kohinoor *et al.* (1993) in their experiments on rice fish culture was almost similar to the production of grain obtained in the present study. Coche (1967) reported that the yield of grain and straw was increased by the introduction of fish into the rice fields, because they ate up harmful organisms such as insects and insect larvae and they also grazed on the weeds. In rice farming alone, weed can reduce yield upto 50%. Akhteruzzaman *et al.* (1993), Kamp and Gregory (1993) and Mazid *et al.* (1993) also

stated that introduction of fish in the rice fields reduced the infestation of insects and weeds by feeding upon them and thereby improves the yield of rice.

The results of the study indicate that culture of *A. mola* in rice field alone gives a low production having positive impact on production of *B. gonionotus* and *C. carpio* in mixed culture system as well as on rice grain and straw yield.

Table 5. The production of rice grain and straw in different treatments

Treatment	Fish species	Production of rice (ton/ha)		% Increased over control	
		Grain	Straw	Grain	Straw
T_1	*A. mola*	5.56^a	7.30^b	12.10	10.27
T_2	*A. mola* *B. gonionotus*	5.62^a	7.61^{ab}	13.30	14.95
T_3	*A. mola* *C. carpio*	5.78^a	7.83^a	16.33	18.28
T_4	Without fish	4.96^b	6.62^c		

Similar superscript denotes no significant difference ($P>0.01$)
Dissimilar superscript denotes significant difference ($P<0.01$

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