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Growth and production performance of red tilapia and Nile tilapia (*Oreochromis niloticus* Lin.) under low-input culture system

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Abstract
Comparative production potential of red tilapia (a mutant hybrid of *Oreochromis niloticus*x*O. mossambicus)* and nile tilapia *(Oreochromis niloticus)* under low-input aquaculture was studied in six ponds of 360 m^2 each with an average water depth of 90 cm. Three ponds were stocked with fingerlings of *O. niloticus* (average weight 11.4±3.48 g) while three other ponds were stocked with red tilapia (average weight 10.72±2.5 g) at a density of 20,000 fingerlings/ha. Supplementary feed consisting of rice bran was given daily at 4-6% of standing biomass. Ponds were fertilized at fortnightly intervals with cattle manure @ 750 kg/ ha. After six months of rearing, gross fish productions of 3,218 and 3,017 kg/ha were obtained from *O. niloticus* and red tilapia ponds, respectively. Of this, table size fish (>80 g in size) production amounted to 2,366 and 2,823 kg/ ha from *O. niloticus* and red tilapia culture, respectively. Analysis of cost and benefits showed higher benefit from red tilapia culture.

Key words : Red tilapia, Nile tilapia

Introduction

Bangladesh abounds in large number of seasonal ponds, ditches, borrow pits and road side canals, which retain water for five to six months and are hitherto lying fellow. Studies undertaken in recent years have indicated the economic viability of culturing short cycle species such as Nile tilapia *(Oreochromis niloticus)* and Silver barb *(Puntius gonionotus)* in such seasonal waters, using agricultural wastes and bi-product as supplementary feed and fertilizers (Gupta 1992, Gupta *et al.* 1994, Hussain *et al.* 1989, Kohinoor *et al.* 1993). One of the problems faced by farmers with regard to the culture of Nile tilapia is its prolific pond breeding resulting in over population leading to stunted growth (Gupta and Shah 1992). Subsequently, red tilapia, a hybrid mutant of *Oreochromis niloticus* and *Oreochromis mossambicus* was introduced into Bangladesh in 1988 from Thailand. Studies undertaken to assess the

economic viability of its culture indicated that gross production of 4,255 kg/ha in 6 months rearing could be obtained using rice bran and mustard oil cake as supplementary feed, accompanied by fertilization of ponds (Akhteruzzaman *et al.* 1993). Fry and fingerlings contributed only 1.3 - 10.8% of total gross production as compared to 11.2 - 41.5% in the case of Nile tilapia (*Oreochromis niloticus)* by Gupta *et al.* (1994), indicating less fry production in the case of red tilapia, resulting in higher production of table size fish. Mustard oil cake though good as supplementary fish feed because of its high protein content , is expensive and its use in aquaculture is beyond the means of resource poor rural farmer. Hence, studies were undertaken to assess the production of red tilapia using only rice bran as supplementary feed and the advantages of its culture, if any, over that of Nile tilapia (*Oreochromis niloticus)* under similar culture management. The results of these studies are presented in this paper.

Materials and methods

The study was undertaken in drainable earthen ponds of 360m^2 each, with an average water depth of 90 cm during October'92 through March '93. The ponds were prepared by draining and application of lime to the pond bottom at the rate of 250 kg/ha. Three days after the application of lime, ponds were filled with ground water and fertilized with cattle manure at the rate of 750kg/ha .

Five days after the application of cattle manure, inorganic fertilizers - urea and triple super phosphate (TSP) were applied at the rate of 8.0 and 17.0 kg/ha, respectively. Three days subsequent to application of inorganic fertilizers, stocking was done: three ponds with fingerlings of Nile tilapia (*Oreochromis niloticus*) of average weight 10.4 (±3.48)g and another three ponds with red tilapia fingerlings of average weight 10.72 (±2.5)g. Stocking density of fingerlings in all ponds was maintained at 20,000/ha. Rice bran (with 5.95% protein) was applied in ponds every day as supplementary feed at the rate of 6% of the standing fish biomass. During December and January months when the temperature of water dropped from 24 to 16 ^{0}C, feeding was reduced to 4 % of standing fish biomass. Subsequent to stocking, all the ponds ware fertilized regularly at fortnightly intervals with cattle manure at the rate of 750 kg/ha. The ponds were sampled at fortnightly intervals to assess growth and condition of fish and feeding was adjusted on the estimated fish biomass in ponds.

Two month after stocking, ponds were netted at fortnightly intervals using a 0.5 cm mesh seine net and the fry/fingerlings caught in the net were harvested. Records were maintained on the number and weight of fry harvested. All the ponds were completely harvested after six months of rearing, first by seining and later by draining the pond. Dissolved oxygen,

pH and temperature of water were measured at weekly intervals using a HACH kit. Student's t-test was used to compare the treatment means at 5% level of significance.

Results and discussion

Temperature and secchi disk transparency of water in ponds during the study period ranged from 18 to 31°C and 16-46 cm, respectively. Dissolved oxygen and pH varied from 2.1 to 6.1 ppm and 7.1 to 8.3 respectively, during the months (Table 1). There was no significant differences ($P<0.05$) in physicochemical characteristics of water in different ponds.

Table 1. Physio-chemical characteristics of pond water during study period

Parameter	October	November	December	January	February	March
Water temperature (°C)	25-31	23-27	18-24	16-22	20-26	22.5-29.0
Secchi disk transparency (cm)	26-46	16-40	16-42	18-28	24-46	16-30
Dissolved Oxygen (mg/l.)	2.8-6.2	2.6-4.8	2.3-6.2	2.1-6.6	2.2-4.8	2.3-5.1
PH	7.5-8.2	7.1-8.0	7.5-8.2	7.1-8.3	7.3-8.3	7.7-8.2

Average growth of fish ranged from 0.40 to 1.37g/day in the case of red tilapia and 0.37 to 1.20 g in the case of Nile tilapia, during different months, the growth decreasing with increase in rearing period. As could be seen from Figure 1, red tilapia grew at a faster rate as compared to Nile tilapia, from the first month of rearing (Table 2). At the end of six months of rearing Nile tilapia attained an average weight of 125 g as compared to 151 g attained by red tilapia.

Growth of fish during the first month after stocking was high in the case of both red tilapia and Nile tilapia, being 1.37 and 1.20 g/day, respectively (Table 2). Subsequently, daily growth decreased and was in the range of 0.40-0.99 g/ day in the case of red tilapia and 0.37 - 0.63 g/ day in the case of Nile tilapia. Growth pattern in both the species was more or less same (Fig.1).

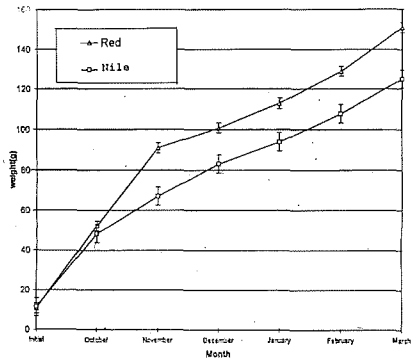

Fig. 1. Average growth of red and Nile tilapias during October'92 to March'93.

Table 2. Average weight and growth rate (g/day) of red tilapia and Nile tilapia in different months during rearing period

Month	Red tilapia		Nile tilapia		t-statistic
	Average weight (g)	Growth/day (g)	Average weight (g)	Growth/day (g)	
Initial	10.72	-	11.40	-	
October	52.00	1.37	48.00	1.20	
November	91.00	0.99	67.00	0.63	
December	101.00	0.67	83.00	0.53	0.64 ^{NS}
January	113.00	0.40	94.00	0.37	
February	129.00	0.53	108.00	0.42	
March	151.00	0.73	125.00	0.59	

**NS= Not significant*

Number and weight of fry and fingerlings harvested from red tilapia and Nile tilapia ponds during different months of rearing are presented in Table 3. Fry of Nile tilapia started coming in the nets from the second month after stocking, while in the case of red tilapia, fry harvesting started three months after stocking, indicating early breeding in the case of Nile tilapia. Fry/ fingerling production was considerably higher in all months in the case of Nile tilapia as compared to that of red tilapia. In case of Nile tilapia, number and weight of fry/fingerlings harvested amounted to 181,639 nos. and 852.78 kg/ha, respectively in six months rearing period, while it was 41,139 nos. and 193.33 kg/ha in the case of red tilapia, indicating that the production of fry/fingerlings in the case of Nile tilapia 4-5 times higher ($P<0.01$) as compared to that of red tilapia.

Table 3. Fry and fingerlings production of red tilapia and Nile tilapia

Species	Fingerlings production (no. and kg/ha)													
	October		November		December		January		February		March		Total	
	No.	Weight	No.	Weight	No.	Weight	No.	Weight	No.	Weight	No.	Weight	No.	Weight
Red tilapia	-	-	-	-	14972	70.42	7194	33.80	5195	24.41	13778	64.70	41139	193.33
Nilotica	-	-	34944	152.78	29278	137.50	14917	81.25	13611	63.89	88889	417.36	181639**	852.78**

***Significant at 0.01 level*

Details of fish production and feed conversion in the case of red tilapia and Nile tilapia are presented in Table 4. Average gross production was found to be lower amounted to 3,017 kg/ha in the case of red tilapia, while it was higher, 3,218 kg/ha ($P<0.01$), in the case Nile tilapia of after six months rearing. Such higher gross production in the case of Nile tilapia seemed to be due to higher ($P<0.01$) production of fry /fingerlings. Table size fish (> 80 g size) was higher ($P<0.01$), 2,823 kg/ha in the case of red tilapia as compared

to Nile tilapia, 2,366 kg/ha. The feed conversion ratio (FCR) in the case of red tilapia was 5.61 while it was lower, 4.68 ($P<0.01$) in the case of Nile tilapia .Observed better feed conversion ratio in the case of Nile tilapia might be related to higher production of fry/fingerlings, resulting in higher biomass.

Table 4. Production and FCR of red tilapia and Nile tilapia

Treatment	Stocking density (no./ha)	Culture period (month)	Production (kg/ha) Marketable size fish (> 80 g)	Fry / fingerlings	Gross production	FCR
Red tilapia	20,000	6	2,823.33**	193.33	3,026.66	5.61**
Nile tilapia	20,000	6	2,365.55	852.78**	3,218.33**	4.68

** *Significant at 0.01 level*

Cost of production and returns from culture of red tilapia and Nile tilapia are presented in Table 5. While estimating cost of production, variable costs such as, lime, feed, fertilizer and fingerlings were taken into consideration. Since low-cost tilapia will be practiced mostly in homestead ponds, cost of pond lease and labor for management of the pond have not been taken into consideration for estimating production economics. Cost of production amounted to Tk. 35,880/ha in six months rearing in the case of red tilapia, while it was Tk. 30,978/ ha in the case of Nile tilapia. Selling price was of red tilapia fry Tk. 300/1000 nos. as compared to those of Nile tilapia (Tk. 200/1000 nos.). At the same time, table size (>80 g) red tilapia commands a higher price in the market (Tk. 45/kg) as compared to Nile tilapia (Tk. 35/kg). This resulted in higher gross revenue from red tilapia culture even though gross production was less. Gross revenue from red tilapia culture amounted to TK. 139,391/ha , leaving a net benefit of Tk. 103,511, while gross revenue from Nile tilapia culture amounted to Tk. 119,122, leaving a net benefit of Tk. 88,144/ha indicating higher profitability from red tilapia culture.

Table 5. Cost and benefits from culture of red tilapia and Nile tilapia in six months

Input	Red tilapia Quantity (kg)	Red tilapia Cost (Tk.)	Nile tilapia Quantity (kg)	Nile tilapia Cost (Tk.)
A. Cost				
Lime	250	750.00	250	750.00
Cattle manure	9,000	3,600.00	9,000	3,600.00
Inorganic fertilizers	25	125.00	25	125.00
Fingerlings	20,000 nos.	6,000.00	20,000 nos.	4,000.00
Rice bran	16,937	25,405.00	15,002	22,503.00
Total cost		35,880.00		30,978.00

B. Benefits				
Marketable size fish				
Red tilapia : Tk. 45/kg	2,823.33	127,049.85	2,365.55	82,794.25
Nile tilapia :Tk. 35/kg				
Fingerlings				
Red tilapia : Tk.0.3 each	41,139 nos.	12,341.70	181,639 nos.	36,327.80
Nile tilapia :Tk. 0.2 each				
Gross benefit		139,391		119,122
Net benefit (B-A)		103,511		88,144

Akhteruzzman *et al.* (1992) reported gross production of 4,235 kg/ha/6 months from culture of red tilapia using rice bran and mustard oil cake as supplementary feed, along with fertilization of ponds with organic and inorganic fertilizers. In the same study they observed that fish production was only 3,121kg/ha in 6 months when fish were provided with supplementary feed, but ponds were not fertilized. Gross production of 3,017 kg/ha/6 months obtained in the present study using low-cost supplementary feed, rice bran and fertilization of ponds, compares well with production obtained using rice bran and mustard oil cake. Gupta *et al.* (1994) reported an average gross production of 2,738 kg/ha/6 months from Nile tilapia (*O. niloticus)* culture using only rice bran as supplementary feed. Gross production of 3,554 kg/ha/6 months was obtained with Nile tilapia (*O. niloticus)* when rice bran and mustard oil cake were used as supplementary feed (Hussain *et al.* 1989).

Tilapia culture in Bangladesh is being undertaken by resource-poor rural farmers as a low-cost, homestead enterprise and in this context culture of tilapia, either it to be red tilapia or Nile tilapia using rice bran as supplementary feed, will be viable as a low-cost technology. Though the present study indicated that Nile tilapia performs well in terms of feed conversion efficiency, its relatively low growth and higher fry production makes it less promising than red tilapia in overall production potential. However, low breeding intensity in case of red tilapia could be a constraint for large-scale seed production.

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