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Growth and production performance of climbing perch Thai Koi and Vietnamese Koi Strain (*Anabas testudineus*) in Bangladesh

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Abstract
The present study was performed for evaluating the growth and production performance of Thai and Vietnamese strain of climbing perch (*Anabas testudineus*) for the period of four months during April to July, 2014. There were two treatments each with three replications. Three ponds under treatment-1 (T-1) were stocked with fry of Vietnamese strain of climbing perch, while other three ponds which designated as treatment-2 (T-2) were stocked with Thai strain of climbing perch. Fish were fed with commercial pelleted feed (30% crude protein). The water quality parameters of pond water were monitored weekly and were within acceptable range for fish culture. The mean harvesting weight of treatment-1 was significantly higher than treatment-2. After four months of rearing, gross fish production of 15,352 and 9,456 Kg/ha were obtained from Vietnamese and Thai strain of climbing perch, respectively. The results demonstrated that the higher mean growth and production were observed in Vietnamese strain than Thai strain of climbing perch.

Keywords: Thai strain of Climbing perch, Vietnamese strain of Climbing perch, Growth, Production**.**

1. Introduction
Climbing perch Koi (*Anabas testudineus*) is an important indigenous fish species of Bangladesh. The fish is very popular for its delicious taste and flavour. This species is considered as a valuable item of diet for sick and convalescent. The fish contains high values of physiologically available iron and copper essentially needed for hemoglobin synthesis [1]. Once climbing perch was abundantly available in almost all freshwater systems of Bangladesh. In late 1980s, the catches of the fish have drastically declined from open waters due to various ecological changes in inland water bodies. Keeping these in view, seed production technology through artificial propagation was developed in captive condition by the Bangladesh Fisheries Research Institute. But in culture aspects, the growth rate of native strain is very slow in ponds ecosystem [2].

To overcome this situation, another fast growing climbing perch known as Thai koi (*Anabas testudineus*) has been introduced from Thailand in 2002. This strain has some special characteristics such as faster growth rate, shorter culture period, higher survival rate etc. Seed production of this species through artificial propagation technique has been developed [3]. But due to the failure of maintaining proper hatchery protocol in fry production phase, inbreeding has resulted the receiving of high yielding characteristics of Thai Koi [4]. To overcome this problem, another variety of Koi was imported from Vietnam in 2010. Seed production and nursing techniques are more or less same as Thai strain. This variety of Koi is getting popularity among farmers in recent years. Research needs to evaluate the culture potentials of Thai and Vietnamese strain of Koi in pond ecology. Therefore, present study is attempted to evaluate the production potentials of Thai koi and Vietnamese Koi at on farm management.

2. Materials and Methods
The production potentials of Thai Koi and Vietnamese Koi were evaluated in six farmer's ponds of 800 m^2 with depth of 1.2 to 1.5 m in Kheruajani under Muktagacha upazilla, Mymensingh district, Bangladesh and lies between 24.7583 °N and 90.2667 °E. Culture period of those fishes were four months during April to July, 2014.

2.1. Pond preparation
The selected ponds were drained and unwanted fishes also removed. The dikes of all ponds were repaired and pond bottom treated with lime at the rate of 250 kg/ha. After that, ponds were filled up with underground water from deep tube well up to the depth of 1 meter.

2.2. Design of experiment
The treated ponds were divided into two treatment groups and each having three replicates. The ponds under treatment-1 (T-1) and treatment-2 (T-2) were stocked with fry of Thai Koi and Vietnamese Koi (*Anabas testudineus*), respectively. The stocking density of both the treatments were same which was 1, 25,000/ha. Before stocking, the initial mean weights of the fry were measured using sensitive balance (Sciencetec Model JSA-210).

2.3 Fish stocking and management
In both the treatments, 30% protein containing pelleted feed (Mega Feed Commercial feed) were applied at the rate of 15-5% of estimated fish biomass twice daily at 10.00 hr in the morning and at 15.00 hr in the afternoon after stocking. The fingerlings were fed at the rate of 15% of their body weight for the first two weeks and it was reduced to 5% on the subsequent weeks. All the ponds were limed at the rate of 125 kg/ha during the culture trial at fortnightly interval.

2.4. Fish sampling
Random samples of 50 individuals from each pond were caught by seine net at 10 days interval. The weight of fish was measured with a help of a portable sensitive balance (TANITA, Japan) to assess the health and growth of fish as well as to adjust the feeding rate.

2.5. Water quality parameters
Water quality parameters like water temperature (°C), transparency (cm), pH, DO (mg/l), alkalinity (mg/l) and ammonia nitrogen (mg/l) were measured weekly interval throughout the study period from 0930 to 1000 hrs. Water temperature was recorded using a Celsius thermometer and transparency was measured by using a Seechi disc of 20 cm diameter. Dissolve oxygen and pH were measured directly using a digital portable oxygen meter (OAKTON) and portable pH meter (HANNA 8424), respectively. Alkalinity was determined following the titrimetric method according to the standard procedure and methods [5]. Ammonia-nitrogen was measured using a high precision HACH Kit (DR 2800).

2.6. Water Refilling
Shallow tube-well was used for adding underground water in the pond (1000 L. day^{-1}). This method mitigated pollution from excretory product of individuals and maintained water quality suitable for the experimental fish.

2.7. Harvesting of fish
After four months of rearing fishes were harvested from all the experimental ponds. Primarily the harvesting of fishes was performed by repeated netting using a seine net and final harvesting was done by dewatering the ponds by submerged low lift pump. During harvesting all fish were counted and weighed from each pond. After harvesting, Specific Growth Rate (SGR), Food Conversion Ratio (FCR), Survival (%) and Production of fishes were calculated and compared between the treatments.

2.8 Statistical analysis
The data were analyzed through one way analysis of variance (ANOVA) using the statistical package, STATGRAPHICS version 7. A simple cost benefit analysis was done to estimate the net benefits from the treatments.

3. Results and Discussions
Detailed result of the study on the growth performance, survival rate, fish biomass, water quality parameters and all other aspects as recorded during the period of experiment are presented.

4. Water quality parameters
A favorable physicochemical condition of water is the major pre-requisite for healthy aquatic environment and better production. A large number of water quality parameters including water temperature, transparency, pH dissolved oxygen, alkalinity and ammonia nitrogen of the pond water were measured regularly throughout the experiment. Mean values of each of the parameter are presented in Table-1.

Temperature is one of the most important physical factors, which influences the physico-chemical and biological environment of a water body. In present analysis temperature varied from 26.80 to 31.80 °C with means of 27.21±0.58 °C and 26.73±0.70 °C in T-1 and T-2, respectively. The difference of temperature between the treatments was not significant (P>0.05). The variations in temperature between the treatments mean were found similar (P<0.05) and were within the suitable range of growth of fish in tropical ponds [6-11]. The range of water temperature from 26.06 to 31.97 °C is suitable for fish culture [12].

The concentration of pH plays a crucial role in the productivity of the water body. pH values of pond water under two treatments were found to be alkaline. The observed ranges of pH values were 7.23-8.90 in T-1 and 7.12-8.75 in T-2, respectively. There was no significant difference (P>0.05) of pH values between two treatments. Different authors have reported a wide variations in pH from 7.18 to 7.24 [13], 7.03 to 9.03 [6], 6.8 to 8.20 [7] and 7.50 to 8.20 [14] in fertilized fish pond and found the ranges productive. The values of pH recorded in the present experiment are well within above reported ranges, indicating the productive nature of the ponds.

Dissolved oxygen is an important chemical factor and its suitable range is critical for success in any aquaculture operation. The mean values of dissolved oxygen concentration in T-1 and T-2 were 6.03±1.03 and 5.91±0.76 mg/l, respectively. But there was no significant (P>0.05) difference between two treatments. It was found that the value of dissolve oxygen is 4.12 to 6.80 mg/L [8], whereas, dissolved oxygen values ranging from 3.80 to 6.12 mg/L [10]. In another study, dissolved oxygen also ranging from 4.80 to 5.95 mg/L during their experiment in farmers pond [11]. Although fish might survive in 0.50 mg/l dissolved oxygen concentration but most suitable range of DO in a water body for fish culture was suggested from 5.0-8.0 mg/l [15]. Though in the present experiment, DO concentration in all treatments were well within the permissible limit.

Total alkalinity ranged from 105 to 155 and 114 to 162 mg L^{-1} with mean values of 125.30±17.09 and 128.50±14.55 mg L^{-1} in T-1 and T-2, respectively. When the results of all ponds collected over the entire experimental periods were compared, there was no significant difference. Higher total alkalinity level in the ponds of two treatments might be due to regular application of lime at fortnightly interval. The variations in

total alkalinity in all the treatments were found in productive range for aquaculture ponds [12-10].

Ammonia-nitrogen is toxic to fish and above a certain level it can cause fish mortality. The range of ammonia-nitrogen was 0.05-0.85 and 0.06-0.92 mg/L in treatments-1 and 2, respectively. The differences among treatments were not significant (P>0.05) when compared using ANOVA. Ammonia-nitrogen values ranged from 0.01-1.55 mg/l in monoculture ponds with SIS (Small indigenous fish species) [18]. The suitable range of ammonia-nitrogen in fish culture is less than 0.1 mg/l [12]. In the present experiment, ammonia-nitrogen content were higher that might be due to higher stocking density in both treatments. The excreta of the fish might be increased ammonia in the ponds. The use of feed or fertilizer caused sediments in the pond bottom which may produce ammonia in the ponds [19]. This might be happened in this experiment.

Table 1: Water quality parameters (mean ±SE) of the ponds under different treatments

Parameters	Treatment-1	Treatment-2
Temperature (°C)	27.21±0.58	26.73 ±0.70
Transparency (cm)	26.75±3.76	30.44±3.11
Dissolved oxygen (mg/L)	6.03±1.03	5.91±0.76
pH range	7.23 – 8.90	7.12-8.75
Total Alkalinity (mg/L)	125.30±17.09	128.50±14.55
Ammonia-nitrogen (mg/L)	0.05-0.85	0.06-0.92

Dissimilar superscript indicates significant
Difference at 5% level of probability

5. Growth and production

Details of stocking, growth parameter, survival and production of koi under two treatments are shown in Table-2. The results indicated that, the growth rate of fishes showed variation between the treatments on the basis of body weight at harvest. It was evident from the results that between the treatment groups in grow-out system, the highest harvesting mean weight 138.91±13.03g was found in T-1 (Vietnamese climbing perch) which was significantly different (P<0.05) from T-2 (Thai climbing perch) when ANOVA was performed. The harvesting mean weight T-1 and T-2 were 138±13.03g and 89±17.60g, respectively. The growth patterns of koi in different months of different treatments are shown in Figure-1 where a clear distinguishable difference in weight was observed in every month among the treatments.

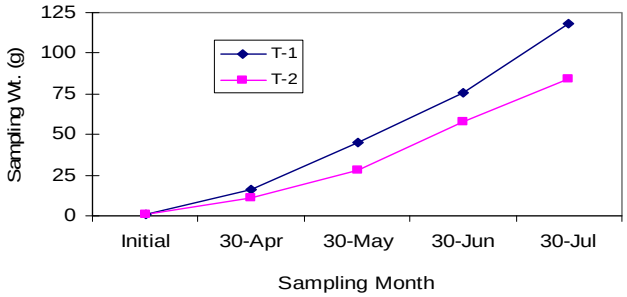

Fig. 1: Monthly sampling weight of fish in two treatments

Based on the number of fish harvested at the end of experiment, survival rate Vietnamese and Thai Koi were 89 and 85%, respectively. There was no noticeable variation in fish survival between the treatments. The survival rate of Thai koi varied from 79 to 92% [8]. The SGR (% per day) of fish in two treatments varied significantly, when compared statistically. The Vietnami Koi showed a higher SGR than Thai Koi. The mean FCR value of T-1 and T-2 were obtained 1.58 and 1.65, respectively. The FCR value of T-1 was found to be significantly (P<0.05) lower which indicates that lower amount of feed was required to produce one unit of fish biomass. The mean production of each species in each treatment was further analyzed by using ANOVA. It was observed that the production of Thai Koi and Vietnamese Koi varied significantly. The production of Koi under Treatmment-1 and 2 were 15,352 and 9,456 kg/ha, respectively. Vietnamese Koi under treatment-1 showed higher production than Thai Koi (T-2).

Table 2: Mean weight, survival, SGR and production of Vietnamese and Thai Koi

Treatments	Stocking Density/ha	Initial Wt. (g)	Mean Harvesting Wt. (g)	Survival (%)	SGR (%)	FCR	Production (kg/ha)
Treatment-1	1,25,000	1.06±0.24	138±13.03	89	4.06	1.58	15,352
Treatment-2	1,25,000	1.04±0.26	89±17.60	85	3.70	1.65	9,456

Benefit and cost analysis (Table-3) showed that, T-1 (Vietnamese Koi) generated the highest return over a period of four months Tk. 7,26,780/ ha., while, the lowest net return was found Tk. 2,64,160/ha from T-2 (Thai Koi). The net benefit was higher in T-1 considering Growth rate, Production, Feed Conversion Ratio (FCR), Survival (%) and Specific Growth Rate (SGR). In the present study, the production as well as economic return obtained was very encouraging in case of Vietnamese Koi rather than Thai Koi.

Table-3. Cost and return analyses of Vietnami and Thai Koi in one hectare area

Inputs	T-1		T-2	
	Quantity (Kg)	Cost (Tk.)	Quantity (Kg)	Cost (Tk.)
• Lease value	-	50,000	-	50,000
• Pond preparation		10,000		10,000
• Fingerling	1,25,000	1,00,000	1,25,000	75,000
• Feed(@ Tk. 50/kg)	24,250	1,21,2500	15,602	7,80,120
• Miscellaneous cost (Harvesting, labour, Lime, chemicals etc.)		50,000		50,000
• Total cost		14,22,500		9,65,120
• Benefits				
• Sell price of Koi T-1: Tk.140/kg T-2: Tk. 130/ kg	15,352	21,49,280	9,456	12,29,280
• Net benefit/ha	7,26,780		2,64,160	

Koi (*Anabas testudineus*) production was 1,800 kg ha^{-1} in India by applying supplementary feed (rice bran, mustard oil cake and fish meal) with the stocking density of 60,000 ha^{-1} in 170 days [20]. By applying the above feed, achieved 702 kg/ha over a period of 11 months, where the stocking density was 1, 25,000 ha^{-1} [20]. The production potentials of native koi in monoculture management at the density of 16,000 ha^{-1} and obtained a production of 450 kg ha^{-1} in five months rearing with supplementary feed consisted of rice bran (50%), mustard oil cake (30%) and fish meal (20%) [21]. In a trial conducted on the effects of stocking density on the growth and production of Thai Koi (*Anabas testudineus*) in Freshwater Station, Bangladesh Fisheries Research Institute at three stocking densities (50,000 to 1, 25,000/ha) by applying supplementary feed (35% crude protein) and observed growth was increased in the treatment with lower stocking density and obtained production 6,480 to 6,617 kg/ha in 150 days culture period [8]. The production potentials of native koi (*A. testudineus*) at different stocking densities (50,000 to 62,250/ha) in Freshwater Station, Bangladesh Fisheries Research Institute, Mymensingh were assessed and found the highest total net yield of 1,916 ha^{-1} over a period of 5 (five) months culture period by applying supplementary feed containing 35% crude protein [17].

In a recent studies production was obtained 4,800 to 5,582 kg/ha in six months culture period from Thai Koi (*A. testudineus*) in monoculture management with supplementary feed [22].

6. Conclusion

From the results obtained of the present experiment, it was observed that the productivity of Vietnamese strain of *A. testudineus* was much higher than Thai strain of *A. testudineus*. The Vietnamese strain might be genetically superior to the Thai strain of *A. testudineus*. These indicated that Vietnamese strain of *A. testudineus* is an excellent candidate for aquaculture perhaps more than other culture species in Bangladesh.

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