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Growth and production performance of Vietnamese climbing perch (*Anabas testudineus*) at farm level in Jashore, Bangladesh

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Abstract. The experiment was carried out to assess the effects of stocking density and management practices on the growth and production performance of exotic climbing perch locally known as Vietnamese koi (*Anabas testudineus*). The monoculture of Vietnamese koi was done from March to June 2017 in 213.33±63.94 m^2 earthen ponds located in Jashore district, Bangladesh. Fingerlings of 2.44±0.04cm total length and 0.22±0.01g weight were stocked at a rate of 22 fingerlings/m^2 in treatment T_1, 55 fingerlings/ m^2 in treatment T_2 and T_3. Supplemental feed (30% protein) was applied at the rate of 3-10% of body weight in T_1 and T_2 while in T_3 fish were fed as practiced by the farmers. After 120 days of culture, the survival rate was estimated at 84.73±16.86%, 64.12±6.36% and 63.50±25.14 for T_1, T_2 and T_3, respectively. The average final body weight of the fish was 72.67±6.03 g in T_1, 53.39±3.49 g in T_2 and 52.55±14.12 g in T_3. The SGR in treatment T_1(4.83±0.07) was higher than T_2 (4.58±0.05) and T_3(4.55±0.23). While, the FCR was comparatively higher in treatment T_3 (1.80±1.15) than T_2(1.75±0.14) and T_1(1.50±0.67). The productionwas estimated at 13,338kg/ha, 18,574.40 kg/ha and 18,179.20 kg/ha in T_1, T_2 and T_3 respectively. The highest net return was estimated in T_1 (Tk. 3,55,877.60/ha) followed by T_2 (Tk. 2,78,122/ha) and T_3 (Tk. 2,56,880/ha), respectively. The BCR was calculated 1.32 for T_1, 1.16 for T_2 and 1.15 for T_3. The stocking number 22/m^2 of Vietnamese koi and good management practices might be helpful for enhanced and sustainable production of Vietnamese koi in the region.
Key words: *Anabas testudineus*, Vietnamese koi, BCR

Introduction

The indigenous climbing perch (*Anabas testudineus*) locally known as koi fish withstand harsh environmental conditions. It thrives in low dissolved oxygen, wide range of temperature and poor water conditions (Habib *et al.*1994) and is very popular for its taste and flavor. Koi contributes 1.4% of the total inland water fish production (FRSS 2012). It is found wild in paddy fields, haors, baors, ponds, swamps, marshes and canals. But in cultural aspects, the growth rate of native strain is very slow in the ponds ecosystem (Kohinoor *et al.*1991). However, to improve this situation, the exotic *Anabas testudineus* strain known as Vietnamese koi was imported to Bangladesh from Vietnam in 2013. Induced breeding was successful and the seed at large scales was available. Now a day, farmers of the Jashore region are farming this species with high stocking densities seems to be earning more profit. But they faced mortality and lower growth rates. However, to standardize the cultural technology with a view to getting

maximum growth, yield and economic benefit, the experiment was envisioned in the Jashore region to conduct through a designed manner.

Materials and Methods

Experimental site and pond facilities: The experiment was carried out for a period of 120 days from 15 March to 15 July 2017, in six experimental ponds at different locations in the *Sadar* Upazilla under Jashore district. The average size of the ponds was 213.33 ± 63.94 m^2 and similar in shape and depth (4-5 feet).

Experimental design: The experiment was carried out with three treatments (T_1, T_2 and T_3) each with two replications. The stocking densities and culture management were compared in ponds with 22, 55 and 55 individuals/m^2 in T_1, T_2 and T_3, respectively.

Pond preparation: The pond water was drained using a low lift pump and the bottom was exposed to sunlight for about two weeks. Liming was done in all ponds at the rate of 250 kg/ha and exposed for a week. After liming the ponds were filled with water up to 4-5 feet. The ponds were fertilized with urea and TSP (Triple super phosphate) at the rate of 2.5 g/m^2 and 1.25 g/m^2 respectively. The ponds were well fenced by fine meshed nylon net with the support of bamboo sticks.

Collection of fish fingerlings: The fingerlings of Vietnamese koi (*A. testudineus*) with initial length and weight of 2.44 ± 0.04cm and 0.22 ± 0.01g were collected from a local firm, namely Afil Aqua Ltd Hatchery, Sharsha, Jashore.

Feed and feeding: Supplemental feed (commercial feed containing 30% protein) was given in T_1 and T_2. The feed of size 0.25mm was applied initially for 30 days at the rate of 10% of the body weight of fishes, then the ration was reduced to 7% with feed of particle size 0.80 mm for another 30 days. The rest of the stipulated time the fish were fed with 5-3% of feed of the particle size of 1.25 mm. The feed was applied twice a day, in the morning (9.30 am) and in the afternoon (4.30 pm). However, T_3 fish were fed as farmers own choice of commercial feed available in the local market.

Sampling: Fish were sampled at 15 days interval by a cast net to monitor the growth and to adjust the feeding ratio. The length and weight were recorded by random sampling of 10 fish from each of replication of the experimental ponds. Length, was measured by using a centimeter scale and weight by using a portable digital balance (grade 1g/1kg).

Water quality parameters: Physico-chemical parameters of pond water were monitored every 15 days interval between 8.00 am to 9.00 am. Water temperature was

recorded using a Celsius thermometer and transparency (cm) was measured by using a secchi disc of 20 cm diameter. Dissolved oxygen and pH were measured directly using a digital electronic oxygen meter and a pocket pH meter. Total alkalinity was determined by titrimetric method. Total ammonia of water samples was determined with the help of a HACH kit (Model:*FF-1A*).

Harvesting and data analysis: Complete harvesting was done at the end of the stipulated 120 days of culture on 15 July 2017. Fish were harvested initially by seinenets and followed by drain out the water of the ponds. All the data that were collected and recorded during the experiment were analyzed statistically by using one way ANOVA, using the Microsoft Excel software package, version 2010 and DMRT was assessed following the method of Dunstone and Yager (2009).

Results

Water quality parameters: Water quality parameters like temperature, pH, dissolved oxygen, ammonia, transparency and total alkalinity were observed at 15 days intervalthroughout the study period (Table I).

Table I. Water quality parameters in earthen ponds stocked with Vietnamese koi

	Treatments		
Parameters	T_1	T_2	T_3
Water temperature (^{0}C)	29.94±1.70	30.16±1.35	30.33±1.37
Water pH	7.75±1.00	7.63±0.85	7.39±1.26
DO (mg/L)	3.21±1.70	3.10±1.34	3.10±0.70
Ammonia (mg/L)	0.75^{a}±0.22	0.29^{b}±0.30	1.00^{c}±0.34
Total alkalinity(mg/L)	213.66^{a}±26.73	277.00^{b}±90.32	258.22^{c}±62.32
Transparency (cm)	28.50^{a}±0.45	30.00^{b}±0.25	31.50^{b}±0.35

*significance at ($p < 0.05$)

Production performance: The average production of koi fish was 13,338.00, 18,574.40 and 18,179.20 kg/ha in treatment T_1, T_2 and T_3, respectively. However, total production of *A. testudineus* varied significantly ($p<0.05$) among the three treatments (Table II). The average weight was 72.67±6.03 g for treatment T_1, while the fish attained 53.39±3.49 g in weight in treatment T_2 and 52.55±14.12 g in weight in T_3. The growth rate in treatment T_1 was higher than treatment T_2 and T_3 indicating lower density can produce the maximum size of table fish with minimum size variation. SGR% in treatment T_1 (4.83±0.07) was higher than T_2 (4.58±0.05) and T_3 (4.55±0.23) (Table II). FCR was comparatively higher in treatment T_3 (1.80±1.15) than T_2 (1.75±0.14) and T_1 (1.50±0.67) respectively (Table II). The highest survival rate was observed in T_1 (84.73±16.86%), followed by T_2 (64.12±6.36%) and T_3

(63.50±25.14%), respectively. There was a significant variation ($p<0.05$) in the survival rate in *A. testudenius* among the treatments (Table II).

Table II. Production performance of *Anabas testudineus* under different stocking densities and management practices

Parameters	Treatments		
	T_1	T_2	T_3
Stocking densities (No./m^2)	22	55	55
Initial length (cm)	2.5±0.04	2.5±0.04	2.5±0.04
Initial weight (g)	0.22±0.01	0.22±0.01	0.22±0.01
Culture duration (days)	120	120	120
Final length (cm)	15.94±3.72	15.73±0.84	14.50±1.68
Final weight (g)	72.67^a±6.03	53.39^b±3.49	52.55^c±14.12
Survival rate (%)	84.73^a±16.86	64.12^b±6.36	63.50^c±25.14
FCR	1.50^a±0.67	1.75^b±0.14	1.80^c±1.15
SGR (%)	4.83^a±0.07	4.58^b±0.05	4.55^b±0.23
Production (kg/ m^2)	1.35^a ±0.23	1.88^b ±0.25	1.84^c ±0.98
Production (Kg/ha)	13,338.00^a ±4,544.8	18,574.40^b ±4,949.00	18,179.20^c ±13,364.80

*Mean± SD (Standard deviation); significance at ($p<0.05$)

Table III. Economic analysis of Vietnamese koi production in earthen ponds

Components	Treatments		
	T_1	**T_2**	**T_3**
Expenditure (Tk/m^2)			
Fingerlings cost (1Tk/Fingerling)	22.00	55.00	55.00
Feed amount (Kg)	2.03	3.29	3.31
Feed cost (52 Tk/Kg)	105.56	171.08	165.60
Liming cost (15 Tk/kg)	1.00	1.00	1.00
Cow dung	--	--	0.50
Urea	1.125	1.125	2.00
TSP	0.50	0.50	1.00
Medicine/drug/chemicals	--	0.25	1.50
Operational cost	4.30	4.70	4.90
Total production cost (Tk/m^2)	112.49	178.65	176.50
Income			
Gross return (Tk/m^2)	148.50	206.80	202.50
Net profit (Tk/m^2)	36.02	28.15	26.00
Net profit (Tk/ha)	3,55,877.60	2,78,122.00	2,56,880.00
BCR (Benefit Cost Ratio)	1.32	1.16	1.15

Discussion

In the present study water quality parameters like temperature, pH, DO (dissolve oxygen), ammonia, transparency and total alkalinity were assessed. Water temperature values observed in the present study were similar to those reported by Begum *et al.* (2003); Kohinoor *et al.*(2007), Mondal *et al.* (2010) and Roy *et al.* (2002). The range of water temperature from 26.06 to 31.97°C is suitable for fish culture (Boyd 1982). The water pH value of three treatments were T_1 (7.75±1.00), T_2 (7.63±0.85) and T_3 (7.39±1.26). Uddin (2002) reported the pH value ranging from 6.24 to 8.88 in freshwater fish culture ponds. However, authors have reported a wide variation in pH from 7.18 to 7.24 (Kohinoor *et al.* 2007), 7.03 to 9.03 (Roy *et al.* 2002), 6.80 to 8.20 (Begum *et al.* 2003) and 7.50 to 8.20 (Chakraborty *et al.* 2005) in fertilized fish ponds and found the ranges to be productive. In the experiment, DO was recorded 3.21±1.70, 3.10±1.34 and 3.1±0.70 mg/L in the treatments T_1, T_2 and T_3, respectively, however, the levels seems to be lower than the minmum required level (>5.00 mg/L) might be due to excessive algal bloom or turbidity due to dyke erosion of those ponds in the areas. The low dissolved oxygen in koi culture pond was also reported and which was more or less similar to (Kohinoor *et al.* 2007; Mondal *et al.* 2010 and Rahman *et al.* 1982). The variations in total alkalinity in all the treatments were found within the productive range for aquaculture ponds and similar to Boyd (1982), Kohinoor *et al.* (1998), Kohinoor *et al.* (2009). The transparency recorded during the experimental period was 28.50±0.45 cm, 30.00±0.25 cm and 31.50±0.35 cm in the treatments T_1, T_2 and T_3, respectively.

The growth rates of *A. testudenius* under different stocking densities showed that the average body weight of 72.67±6.03 g for T_1, while the fish attained 53.39±3.49 g in weight in T_2 and 52.55±14.12 g in weight in T_3. The average weight gain of Vietnamese koi at the harvest time was 88.99±2.00, 86.99±1.00 and 85.01±1.02 g for T_1, T_2 and T_3, respectively (Hoque *et al.* 2017). The growth obtained in the present study was more or less similar to the findings of (Kohinoor *et al.* 2007). The highest growth was obtained in T_1 and lowest in T_3. Higher growth rate was attained at stocking densities recommended by BFRI (22 fingerlings/m^2), management and vice versa which has the similarity with the findings of some authors (Islam *et al.* 1978 and Kohinoor *et al.* 2007). The highest survival rate was observed in the treatment T_1 (84.73±16.86%), T_2 (64.12±6.36%) and T_3 (63.50±25.14%), respectively. The survival rate of Vietnamese koi was recorded 95.12±1.12, 95.00±2.00 and 92.50±2.20 (%), in the T_1, T_2 and T_3, respectively at the harvesting time. There was a significant variation ($p<0.05$) in the survival rate in *A. testudineus* among different treatments. SGR% in treatments were T_1 (4.83±0.07), T_2 (4.58±0.05) and T_3 (4.55±0.23) respectively. The SGR was not significantly difference ($p>0.05$) among the treatments however, those were comparatively higher than 3.65-3.95 (Ahmed *et al.* 2014). FCR was comparatively higher in treatment T_3 (1.80±1.15) than T_2 (1.75±0.14) and T_1 (1.50±0.67) respectively, however, more or less similar to

reported works (Ahmed *et al.* 2014;Chakraborty *et al.* 2014 and Islam *et al.* 2002). The mean production of koi fish was 13,338kg, 18,574.40kg and 18,179.20 kg/ha in T_1, T_2 and T_3, respectively. The study revealed that, the production potentials of Vietnamese koi in monoculture management at the density of 16,000/ha and obtained a production of 450 kg/ha in five moths rearing (Akhteruzzaman 1988). The highest production was observed to be 6,175 kg/ha/90 days in treatment T_3, 5,434 kg/ha/90 days in treatment T_2 and the lowest production was observed to be 4446 kg/ha/90days in treatment T_1 at stocking densities 3.75, 6.25 and 8.75 fingerling/$m^2$and designated as treatment T_1, T_2 and T_3, respectively (Ahmed *et al.* 2015). The cost of production was lower in T_1 (11,11,401.20Tk/ha) than T_2 (17,65,062 Tk/ha) and T_3 (17,43,820 Tk/ha). At the end of the experiment, the net profit was calculated as 3,55,877.60Tk/ha, 2,78,122.00 Tk/ha and 2,56,880Tk/ha in T_1, T_2 and T_3, respectively. The net profit was 2744.05 Tk./decimal in T_1, followed by T_2 (2599.12) and T_3 (2449.36) (Hoque *et al.* 2017). In the study, BCR (benefit cost ratio) value were 1.32, 1.16 and 1.15 in treatments T_1, T_2 and T_3 respectively. The BCR was reported 1.7, 1.63 and 1.56 by Ahmed *et al.* (2015) value were estimated 1.26, 1.24 and 1.22 by Hoque *et al.* (2017) in their respective experimental cultural practice of climbing perch.

In the Jashore region, farmers cultre Vietnamese koi with a comparatively higher stocking density (but not less than 55/m^2) and applied huge amount of inputs. Though they stock higher, but their management practices like maintenance of water, seed and feed is poor. For this reason, farmers lose their business. At the end of the experiment, it was revealed that, Vietnamese koi culture will be potential in the region by reducing risk with proper feed and water management. The stocking number 22/m^2 of Vietnamese koi and good management practices might be helpful for sustainable production in the region.

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