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Performance of Indian and Vietnamese Strain of *Anabas testudineus* under Captive Condition in the Lower Brahmaputra Valley Zone of Assam

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ABSTRACT

The present study was performed for evaluating the growth and production performance of Indian and Vietnamese strain of Koi (*Anabas testudineus*) in the rectangular cemented tank of size (10 ft X 6 ft) in the experimental farm of Livestock Research Station, Hekera, Mondira, Assam Agricultural University, Assam for the period of four months during, 2018. There were two treatments each with three replications. Three tanks each under treatment-1 (T1)and treatment-2 (T2) were stocked@ 200 number/ tank with Indian strain of climbing perch fry of (0.60±000) g andVietnamese strain of climbing perchfry bearing weight of (0.59±001) g, respectively. Fish were fed with commercial pellet feed named "Abis" two times in a day @ of 60% (1st month), 25% (2nd month),10% (3rd Month) and 5% (4thmonth) of their body weight in all treatments. The mean FCR value of T1 (Indian Koi) and T2 (Vietnamese Koi) were obtained 1.49±0.01 and 1.29±0.00, respectively. The water quality parameters of tank water monitored monthly were within acceptable range for fish culture. The lowest SGR (%) value (2.91±0.000) was recorded in T1 and the highest (6.09±0.003) in T2. The survival rates were 85.33±0.88 and 90.67±1.45 for T1 and T2, respectively.The mean harvesting weight of treatment2 was significantly higher than treatment1. After four months of rearing, the highest fish production of 53.56kg/0.002ha was obtained from Vietnamese strain of Koi in (T1) followed by17.75kg/0.002ha from Indian strain of climbing perchin (T2), respectively. The highest benefit or net return for T2 was Rs 4350/-0.002 ha and BCR of 1.68 followed by Rs. 1153/0.002hain T1 with BCR value of 1.35.The results demonstrated that the higher mean growth and production were observed in Vietnamese strain (T2) than Indian strain (T1) of climbing perch.

Key Words: Climbing perch, Mean growth, Vietnamese koi, Water quality.

INTRODUCTION

The climbing perch (*Anabas testudineus)* of the family Anabantidae also popularly known as 'Koi' in India is a small sized food fish, which inhabits both freshwater and brackish water. Climbing perch Koi 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 (Saha,1971).

The climbing perch, Anabas testudineus (Bloch 1792) is an important indigenous air-breathing fish in India and it fetch high market price (Rs.300-500/ kg) in the states of Assam, Bihar, Jharkhand, Odisha, Manipur, Tripura and West Bengal (Kumar *et al*,

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2013a). It is popularly known as kavai in Hindi, kou in Odisha, koi in West Bengal and kai in Assam. It has a wide range of geographical distribution due to its exceptional physiological adaptation with respect to air breathing habit and salinity tolerance (Kumar *et al,* 2012). Due to the air breathing ability and tolerance to extreme unfavorable environmental conditions, this species is treated as a prominent candidate fish for aquaculture (Sarkar *et al,* 2005). The possession of accessory respiratory organs enables the species to be farmed at high stocking density (Anantharaja *et al,* 2017). The fish contains very high amount of physiologically available iron and copper required for haemoglobin synthesis (Kumar *et al,* 2013b); as well as essential amino acids and easily digestible polyunsaturated fatty acids (Zalina *et al,* 2012). Due to its air breathing ability and tolerance to adverse environmental conditions, it is a good fish for climate resilient aquaculture.

The perch, *Anabas testudineus*, has been designated as threatened species in Indian water by National Bureau of Fish Genetics Resources, Allahabad, India (Dehadrai*et al* 1992) and also has been declared endangered by NBFGR, ICAR, India in 1998.Among small indigenous fishes *A. testudineus*is an economically important fish of north eastern parts of India. The fish has awide range of distribution in the freshwaters and is prevalent in the derelict and swampy waters. It is omnivorous in nature and attains sexual maturity in the first year. Although culture, breeding and larval rearing technology of the major carps has been developed for the decades,other species having commercial importance have been ignored. Recently, *A. testudineus* is considered as one of the potential new candidate species for aquaculture and captive breeding (Ponniah and Sarkar 2000; Ayyappan*et al.* 2001).

Research needs to evaluate the culture potentials of Indian and Vietnamese strain of Koi in pond ecology. It was observed that Vietnamese strain of Koi is getting popularity among farmers in recent years as a new candidate species for aquaculture diversification in India along with other parts of the world. Therefore, present study was attempted to evaluate the production potentials of Indian koi and Vietnamese Koi in tanks culture system under proper management.

MATERIALS AND METHODS

The growth and production potentials of Indian and Vietnamese Koi were evaluated in six rectangular shape cemented tanks of 60 sq ft with depth of 4 ft in the experimental farm of Livestock Research Station, Hekera, Mondira, Assam Agricultural University, Kamrup (Rural) District, Assam which lies between Latitude- N $26^0$3’26.3178” and Longitude-E $91^0$4’5.57364’. Culture period of those fishes were four months during 28th April to 28th August, 2018.

The selected tanks were drained, cleaned and unwanted fishes were removed one month prior to fish seed stocking. The tank bed treated with lime at the rate of 200 kg/ha. After that, ponds were filled up with underground water from deep tube well up to the depth of 3 ft.The treated tanks were divided into two treatment groups and each having three replicates. The tanks under treatment1 (T1) and treatment2 (T2) were stocked with fry of Indian Koi and Vietnamese Koi (*Anabas testudineus*), respectively. The stocking density of both the treatments was same @ 200/tank of 60 sq ft area. Before stocking, the initial mean weights and initial mean length of the fry were measured using electronicprecision balance.

Fish stocking and management

In both the treatments, 30 per cent protein containing pelleted feed (Abis Commercial pelleted feed) were applied two times in a day (morning at 9.00 am and afternoon 4.00 pm) @ of 60% (1st month), 25% (2nd month),10% (3rd Month) and 5% (4thmonth) of their body weight of all treatments afternoon after stocking.

Random samples of 10 individuals from each tank were caught by drag net at one month intervalin

the morning at around 7:30 to 8:30 am. During each sampling, weight was taken by precision weighing electronic balance. Weight gain (g), average daily weight gain (g), percent weight gain, specific growth rate (SGR), food conversion ratio (FCR), survival rate (%) and production (kg/0.002ha/120days) parameters was used to evaluate the growth and fish production.

Water quality parameters

Hydrological parameters like water temperature (°C),transparency (cm), pH, DO (mg/l), alkalinity (mg/l) andammonia nitrogen (mg/l) in all tanks were measured in monthly interval throughout the study period from 08:30 to 09:30 hr. Water temperature was recorded using a Celsius thermometer and transparency was measured by using a Seechi disc of 20 cm diameter. Dissolve oxygen, pH and Alkalinity were measured directly by using water quality parameter measurement kits in mg/l. All the parameters were analyzed as per the standard methods (APHA 2005).

Water refilling

Shallow tube-well was used for adding underground water to replace 10 per cent of total volume of water in monthly interval to reduce the risk of pollution from uneaten feed particles and fish faecal matters and to maintain water quality suitable for the experimental fish.

Harvesting of fish

After four months of rearing, fishes were harvested from all the experimental tank. Primarily the harvesting of fishes was performed by repeated netting using a small drag 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 tank. After harvesting, specific growth rate (SGR), food conversion ratio (FCR), survival (%) and production of fishes were calculated and compared between the treatments.

Statistical analysis

The data pertaining to fish growth were analyzed through Independent Sample T Test and data pertaining to water quality parameters were analyzed through One Way ANOVA by using the statistical package, SPSS version 16. A simple cost benefit analysis was done to estimate the net benefits from the treatments.

RESULTS AND DISCUSSION

Water quality parameters

Temperature

It is one of the most important physical factors which influence the physico-chemical and biological environment of a water body. In present analysis temperature varied from 26.94 to 29.20 °C with means of 28.30 ±0.21 °Cand from 26.99 to 29.14 °C with means of 28.30 ±0.20°C in T1 and T2, respectively. The difference of temperature between the treatments was non-significant (P>0.05).The variations in temperature between the treatments mean were found similar (P<0.05) and werewithin the suitable range of growth of fish in tropical ponds (Mandal*et al,*2010;Chakraborty and Nur, 2012, Jahan*et al,* 2013).The range of water temperature from 26.06 to 31.97 °C is suitable for fish culture.

pH

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 7.77±0.07 and 7.55±0.07 in T1 and T2, respectively. There was significant difference (P<0.05) of pH values between two treatments. Ahmed *et al.* (2012) found pH ranged from 6.5 to 8.5.The optimum pH for most species is between 7 and 8.5 (Boyd,2017). The values of pH recorded in the present experiment are well within above reported ranges, indicating the productive nature of the ponds.

Dissolved oxygen

Dissolved oxygen is an important chemical parameter for growth and survivability of fish and its suitable range is critical for success in any aquaculture operation. The mean values of dissolved oxygen concentration in T1 and T2 were

6.08±0.20 and 5.89±0.24 mg/l,respectively. There was no significant (P>0.05) difference between two treatments. The above values of DO concentration in the present experiment is found to be similar with the findings of the dissolved oxygenvalues recorded between 3.80 to 6.12 mg/L by (Chakrabortyet *al,* 2012). and4.80 to 5.95 mg/L during the experiment in farmers pond (Jahan*et al,*2013). Although fish might survive in dissolved oxygen concentration of 0.50 mg/l but most suitable range of DO in a water body for fish culture was suggested from 5.0-8.0 mg/l. In the present experiment, DO concentrations in all treatments were well within the permissible limit.

Total alkalinity

Total alkalinity ranged from 105 to 155 and 105 to 154 mg/ L with mean values of 126.27±4.39 and 129.07±4.70 mg/ Lin T1 and T2, respectively. When the results of all ponds collected over the entire experimental periods were compared,there was no significant difference (P>0.05). Higher total alkalinity level in the tanks 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, which agrees with the findings of Chakraborty and Nur (2012).

Ammonia-nitrogen

Ammonia-nitrogen is toxic to fish and above a certain level it can cause fish mortality. The range of ammonia-nitrogen was 0.05±0.01 mg/L in both the treatments1 and 2, respectively. The differences among treatments were not significant (P>0.05) when compared using ANOVA.It is reported that Ammonia-nitrogen values ranged from 0.01-1.55 mg/l in monoculture ponds with SIS (Small indigenous fish species) (Kohinoor *et al,* 2019). The suitable range of ammonia-nitrogen in fish culture is less than 0.1 mg/l. In the present experiment, ammonia nitrogen content were higher that might be due to higher stocking density in both treatments. The uneaten feed and excreta of the fish might have increased ammonia in the tanks. The use of feed or fertilizer caused sediments in the pond bottom which may produce ammonia in the ponds. This might have happened in this experiment.

Growth and production

The results indicated that, the growth rate of fishes showed variation between the treatments on the basis of body weight at harvest. It was apparent from the results that between the treatment groups in grow-out system, the highest harvesting mean weight 98.51±0.09g was found in T2 (Vietnamese climbing perch) which was significantly different (P<0.05) from T1 (Indian climbing perch) when Independent Samples was performed. The harvesting mean weight T1 and T2 were 34.72±0.02g and 98.51±0.09g, 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.

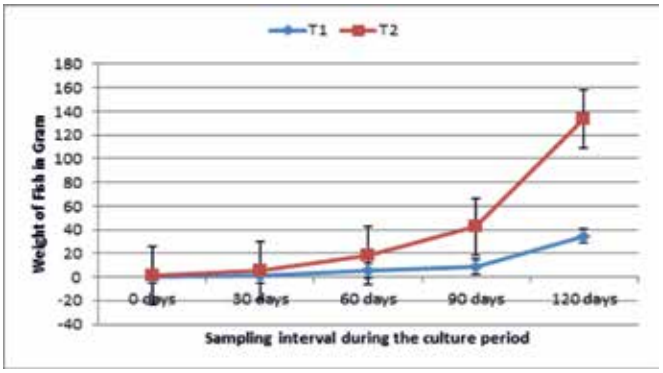

Fig. 1:Graph of Monthly Sampling Mean weight of fishes in two treatments

Based on the number of fish harvested at the end of experiment, survival rate of Indian and Vietnamese Koi were 85.33 and 90.67 per cent, respectively. There was no noticeable variation in fish survival between the treatments. The survival rate of Indian koi and Vietnamese Koi varied from 84 to 87per cent and 88 to 93per cent, respectively. The SGR (% per day) of fish in two treatments varied significantly, when compared statistically. The Vietnami Koi showed a higher SGR than Indian Koi. Hence, the present research is found to be similar with the findings of (Kohinoor *et al* 2016) who reported higher survivability % and

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

Parameter	Treatment1	Treatment2
Temperature (^{0}C)	28.30 ±0.21	28.30 ±0.20
pH range	7.77±0.07	7.55±0.07
Dissolved oxygen (mg/L)	6.08±0.20	5.89±0.24
Total alkalinity (mg/L)	126.27±4.39	129.07±4.70
Ammonia nitrogen (mg/L)	0.05±0.01	0.05±0.01

SGR of Vietnamese strain is than the Thai Koi. The mean FCR value of T1 (Indian Koi) and T-2 (Vietnamese Koi) were obtained 1.49±0.01 and 1.29±0.00, respectively. The FCR value of T2 was found to be significantly (P<0.05) lower than the FCR of T1, which indicates that lower amount of feed was required to produce one unit of fish biomass. The present research confirms the findings of (Ahmed *et al* 2014) and (Kohinoor *et al* 2016) who reported lower FCR value of Vietnamese Koi while comparing with Thai strain of Koi in mini pond culture system and farmers pond respectively..

The mean production of each species in eachtreatment was further analyzed by using Independent T Test. It wasobserved that the production of Indian Koi and Vietnamese Koivaried significantly. The production of Koi under Treatment1 and 2 were 17.75 and 53.56 kg/0.002ha, respectively.Vietnamese Koi under treatment2 showed higher productionthan Indian Koi (T1), which corroborate the findings of (Ahmed *et al* 2014), who recorded higher production and growth rate of Vietnam koi in comparison to Thai koi under mini pond culture condition.

Benefit and cost analysis (Table6) showed that T2 (Vietnamese Koi) generated the highest return over a period of four months Rs. 4,350/0.002ha., while, the lowest net return was found 1154/0.002ha from T1 (Indian Koi). The net benefit was higher in T2 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 Indian Koi.

CONCLUSION

Theresultsobtained in the present study revealedthat the productivity of Vietnamese strain of *A.testudineus*was much higher than Indian strain of *A. testudineus*. The Vietnamese strain might be genetically superior to the Indian strain of *A. testudineus*. These indicated that Vietnamese strain of *A. testudineus*is an excellent candidate for commercial aquaculture perhaps more than other strain.

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Table 2: (Mean±SEM) Length & weight of two strains of *Anabustestudineus* cultured in tanks for four months (Independent samples T test)

Treatment	Initial Wt(g)	Initial Length (cm)	Wt (g) after 1st month	Lt (cm) after 1st month	Wt(g) after 2nd month	Lt (cm) after 1st month	Wt(g) after 3rd month	Lt (cm) after 3rd month	Wt(g) after 4th month	Lt (cm) after 4th month
Local Koi(T1)	0.60±000	1.50±0.03	1.56±0.02	2.18±0.02	5.63±0.02	5.81±0.02	8.23±0.01	10.39±0.01	34.73±0.02	11.79±0.02
Vietnamese Koi (T2)	0.59±0.01	1.49±0.02	3.73±0.003	3.75±0.00	12.44±0.04	8.54±0.01	34.12±0.04	12.79±0.03	98.51±0.09	18.64±0.09
Sig.(2 tailed) (P)	0.643	0.714	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 3: Monthly weight gain (g) and length increment (cm) of two strains of *Anabustestudineus* cultured in tanks for four months (Mean±SE)

Strain of *Anabus testudineus*	Weight gain(g) after 1 month	Weight gain(g) after 2month	Weight gain(g) after 3 month	Weight gain(g) after 4 month	Length (cm) increment after 1st month	Length (cm) increment after 2nd month	Length (cm) increment after 3rd month	Length (cm) increment after 4th month
Local Koi(T1)	0.96±0.02	5.03±0.02	7.63±0.01	34.13±0.02	0.67±0.02	4.30±0.02	8.88±0.01	10.28±0.02
Vietnamese Koi (T2)	3.13±0.003	11.84±0.04	33.52±0.04	97.91±0.09	2.26±0.00	7.05±0.01	11.29±0.03	17.15±0.09
Sig.(2 tailed) (P)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 4. Weight gain (%) and Specific growth rate (%) of two strains of *Anabustestudineus* cultured in tanks for four months (Mean±SE)

Strain of *Anabus testudineus*	Weight gain (%) after 1 month	Weight gain (%) after 2 month	Weight gain (%) after 3 month	Weight gain (%) after 4 month	SGR(%) after 1st month	SGR(%) after 2nd month	SGR(%) after 3rd month	SGR(%) after 4th month
Local Koi(T1)	160.09±3.85	838.70±3.83	1271.80±1.29	5688.70±2.69	3.18±0.05	3.73±0.006	2.91±0.000	3.38±0.000
Vietnamese Koi (T2)	520.56±0.73	1973.43±6.74	5586.40±6.58	16318.0±14.85	6.09±0.003	5.05±0.005	4.49±0.000	4.25±0.000
Sig.(2 tailed) (P)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 5. Mean weight, survival, SGR (%) and production of Indian and Vietnamese Koi during the 4 months culture experiment.

Treatment	Stocking density/ 0.002ha	Initial Wt. (g)	Mean Harvesting Wt. (g)	SGR (%)	FCR	Survival (%)	Production (kg/0.002ha)
Treatment1	200	0.60±000	34.73±0.02	3.38±0.000	1.49	85.33	17.75
Treatment2	200	0.59±0.01	98.51±0.09	4.25±0.000	1.29	90.67	53.56

Table 6:Cost and return analysis of Indian & Vietnamese Koi in 0.002 hectare (16.72sqm) area

Input	T1		T2	
	Quantity (kg)	Cost(Rs.)	Quantity (kg)	Cost(Rs.)
Fry	600	600.00	600	600.00
Feed (@ Rs. 40/-/kg)	26.49	1192.26	69.19	2767.78
Other Miscellaneous cost (Tank preparation harvesting, labour, lime, chemicals etc.)	-	1500.00	-	3000.00
Total cost		3292.26		6367.78
Gross benefits/16.72 sq meter		4445.88		10717.78
Sell price of Indian Koi(T1) @ Rs. 230/kg and Vietnamese Koi(T2): Rs. 200/ kg	17.75 kg fish		53.56 kg fish	
Net benefit/16.72 sq meter		1153.62		4350.00
BCR (Gross Benefit/ Gross Investment)	1.35		1.68	

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