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J. Bangladesh Agril. Univ. 9(2): 345–349, 2011 ISSN 1810-3030

Morphological variability of the 11th generation strain of nile tilapia, (*Oreochromis niloticus*) and traditional genetically improved farmed tilapia

K. M. Shahriar Nazrul, A–A. Mamun[1], B. S. Sarker[1] and U. S. Tonny
Department of Fisheries Biology and Genetics, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh and [1]Department of Fisheries and Marine Science, Noakhali Science and Technology University, Noakhali-3202, Bangladesh. Email: shahriar_rimon@yahoo.com

Abstract

To investigate the morphological variations 12 morphometric and 11 meristic characters were studied for 100 individuals of the same age of traditional strain GIFT (5th generation) and recently developed 11th generation strain (GIFU) of Nile tilapia, *Oreochromis niloticus*. No significant difference was found between total length and other body measurements at 5% level. However, GIFU showed faster linear growth on body depth, maximum body circumference and minimum body circumference where GIFT showed faster linear growth on standard length and head length. On meristic characters, notable variations were observed in case of scale above and below the lateral line, where GIFU individuals showed greater number of scales in both cases. The total length and body weight relationship of both the strains were found to be straight line in logarithmic scales. The mean values of condition factor (K) have been found to be 1.671 for GIFT and 1.711 for GIFU and the mean values of relative condition factor (Kn) were 1.001 and 1.002 for GIFT and GIFU respectively. Findings of the present study suggested the variability of strain GIFU and GIFT in some important parameters.

Keywords: Morphometric, Meristic, GIFT, GIFU, *Oreochromis niloticus*

Introduction

Oreochromis niloticus, popularly known as ‘Nile Tilapia’ all over the world, is an important commercial fish species in Bangladesh and contributes a major share in the culture fisheries. The cultivation of tilapia is becoming more and more popular due to its higher growth rate. A total of 35 seed production hatcheries have been established which are producing 10-12 billion fry every year and a number of commercial farms have also been established, which are producing roughly about 0.02 million tons of marketable size fish (Hussain, 2008). Mossambique tilapia (*Oreochromis mossambicus*) was the first species, which was introduced in Bangladesh from Thailand in 1954. The fish did not flourish due to its early maturation and prolific breeding habits in the ponds. As a result, producers and consumers regarded the fish as “nuisance fish” (Hussain, 2004). Genetically improved farmed tilapia (GIFT) was introduced by Bangladesh Fisheries Research Institute (BFRI) from the Philippines in 1994 and according to BFRI study the growth was found at least 40% higher than the existing stock of Tilapia (Rahman, 2005). GIFU, the 11th generation of tilapia is a recent introduction in Bangladesh. It has 20% higher growth rate, higher fillet ratio and attractive fillet color (light pink) than other available strains of *Oreochromis niloticus* (Zubin Agrobased Industries Limited, 2010). No published data is yet been obtained about the general biology, growth or breeding behavior of this strain. This research work is therefore designed to identify the morphometric and meristic variations between the 5th generation GIFT and 11th generation GIFU strain of nile tilapia, (*Oreochromis niloticus*).

Materials and Methods

100 individuals of each strain of the same age and total length ranging from 115 mm to 257 mm were collected from earthen ponds of Zubin Agrobased Industries Limited, Noakhali. Total length (TL), standard length (SL), head length (HL), pre-orbital length (PreOL), eye diameter (ED), post-orbital length (PostOL), inter-orbital length (IOL), snout length (SnL), mouth gape (MG), maximum body circumference (MaxBC), minimum body circumference (MinBC) and body depth (BD) of fish were measured to the nearest mm using fish measuring board. The fishes were weighed on tanetag, KD-160 balance having one gm precision. Meristic characters which were studied are dorsal fin spines (DFS), dorsal fin soft rays (DFSR), pectoral fin soft rays (PecFSR), pelvic fin spines (PelFS), pelvic fin soft rays (PelFSR), anal fin

spines (AFS), anal fin soft rays (AFSR), caudal fin rays (CFR), branchiostegal rays (BrgR), scale above lateral line (SALL) and scale below lateral line (SBLL). The body characters *viz*. SL, HL, PreOL, ED, PostOL, IOL, SnL, MG, Max BC, Min BC, BD were expressed as percent to total length of the fish as done by Carlender and Smith (1954) and Hile (1948). Regression of various body parts against TL of fish were drawn by least square method.

Length-weight relationship was calculated by cube law as given by Le Cren (1951).

$$\log W = \log a + b \times \log L$$

Where, W is weight, L is length of fish and 'a' and 'b' are constants.

$$K = \frac{W \times 10^5}{L^3}$$

Where, K is condition factor, W is observed body weight of fish and L is observed length of fish.

$$Kn = \frac{W}{W'}$$

Where, Kn is relative condition factor, W is observed body weight of fish (g) and W' is calculated body weight of fish (g).

Regression of morphometric characters between GIFT and GIFU were compared by Snedacor (1956).

Results and Discussion

From morphometric characters it was observed that, the mean (±SD) total length of GIFU (176.73±30.37 mm) was slightly larger than GIFT (173.88±33.61 mm) whereas, the mean (±SD) body weight of GIFU (103.63±50.16 g) was also larger than GIFT (97.03±48.98 g). Other morphometric measurements for GIFT and GIFU were standard length 137.34±26.73 mm & 139.14±24.65 mm, head length 49.81±10.19 mm & 48.45±7.74 mm, pre-orbital length 16.4±3.85 mm & 15.45±2.97 mm, eye diameter 9.98±1.61 mm & 9.72±1.29 mm, post-orbital length 23.3±4.84 mm & 23.39±4 mm, inter-orbital length 34.62±6.79 mm & 35.46±6.5 mm, snout length 15.03±2.91 mm & 15.67±2.8 mm, mouth gape 19.14±5.22 mm & 18.41±4.04 mm, maximum body circumference 129.91±22.75 mm & 135.55±22.49 mm, minimum body circumference 46±7.66 mm & 48.3±7.86 mm, body depth 52.79±9.03 mm & 54.65±8.82 mm respectively.

No significant (p<0.05) difference was found between total length and other variables *viz.* standard length (Fig.1), head length, pre-orbital length, eye diameter, post-orbital length, inter-orbital length, snout length, mouth gape, maximum body circumference, minimum body circumference and body depth of both GIFT and GIFU (Table 1).

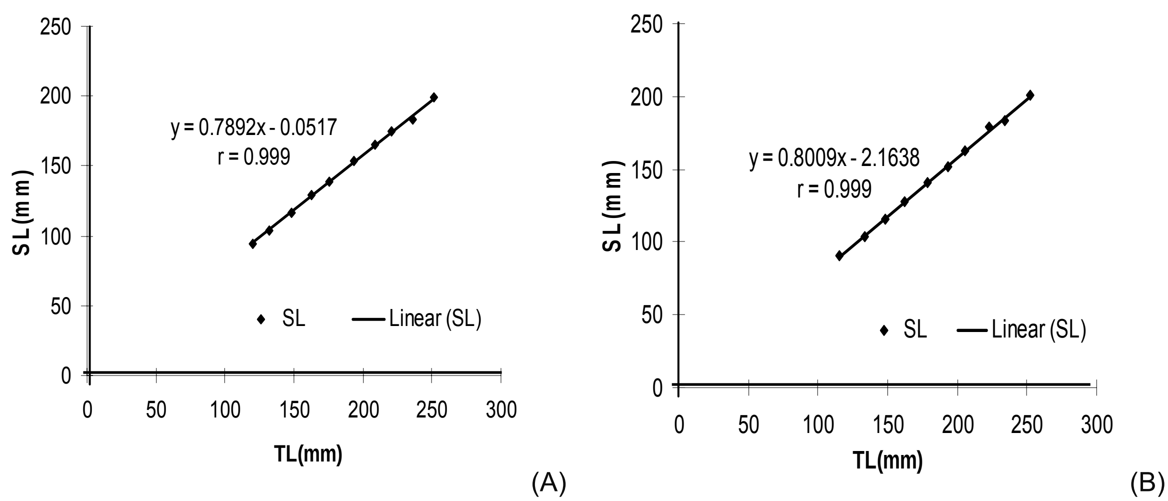

Fig.1. Relationship between standard length (SL) and the total length (TL) of (A) GIFT and (B) GIFU

Table 1. Regression equations for both GIFT and GIFU strains

GIFT						GIFU					
Y=	a	+	b	TL	"r"	Y=	a	+	b	TL	"r"
SL=	-0.05	+	0.79	TL	0.999	SL=	-2.16	+	0.8	TL	0.999
HL=	-2.97	+	0.3	TL	0.998	HL=	4.77	+	0.25	TL	0.997
PreOL=	-3.34	+	0.11	TL	0.993	PreOL=	-0.06	+	0.09	TL	0.969
ED=	2.97	+	0.04	TL	0.972	ED=	3.39	+	0.03	TL	0.972
PostOL=	-1.46	+	0.14	TL	0.976	PostOL=	0.41	+	0.13	TL	0.999
IOL=	0.79	+	0.19	TL	0.996	IOL=	-1.48	+	0.21	TL	0.961
SnL=	1.21	+	0.08	TL	0.983	SnL=	-0.07	+	0.09	TL	0.974
MG=	-6.8	+	0.15	TL	0.988	MG=	-3.3	+	0.13	TL	0.961
MaxBC=	22.05	+	0.61	TL	0.989	MaxBC=	9.57	+	0.71	TL	0.995
MinBC=	10.34	+	0.2	TL	0.988	MinBC=	2.04	+	0.26	TL	0.991
BD=	10.98	+	0.24	TL	0.982	BD=	4.31	+	0.28	TL	0.998

Percentage values (Fig. 2) of standard length of GIFT (78.99) was slightly higher than the standard length (78.73) of GIFU. Again, the percentage of body depth at pectoral fin-base in GIFU (30.92) was higher than that of GIFT (30.36). A close examination of values of the characters revealed a strong heterogeneity between GIFT and GIFU. The GIFU were broader in anterior part of the body at pectoral fin than the GIFT where GIFT (28.65%) having longer head than the GIFU (27.41%). The maximum body circumference and minimum body circumference of GIFU (76.7% & 27.33% respectively) were higher than that of GIFT (74.71% & 26.46% respectively).

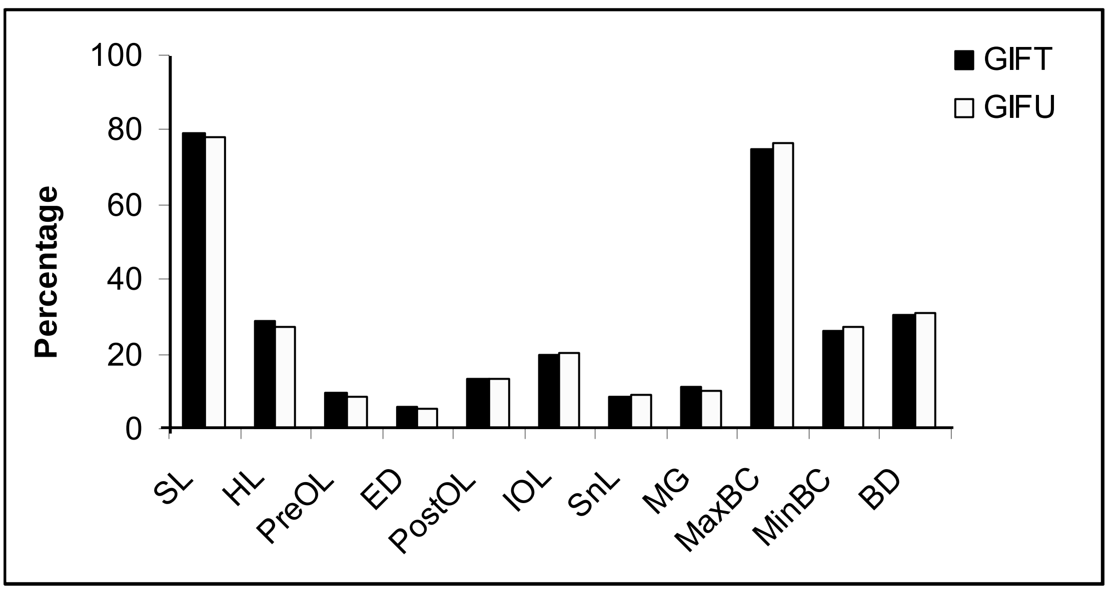

Fig. 2. Growth of different morphometric body parts of GIFT & GIFU when considering the total length (TL) as 100%

Thus it may be inferred that GIFU showed faster linear growth on body depth, maximum body circumference and minimum body circumference where GIFT showed faster linear growth on standard length and head length. Devi *et al.* (1991) reported the value of head length (24.91%) of males to be higher than that of females (22.91%) and the value of depth of body at pectoral fin-base in females (21.09%) to be higher than that of males (19.50%) in *Rita rita*. This finding is similar to the present study. Such phenomenon was also reported by Khumar (1985).

In case of dorsal fin spines (16-17), dorsal fin soft rays (11-13), pectoral fin soft rays (13-14), pelvic fin spines (1), pelvic fin soft rays (5), anal fin spines (3), anal fin soft rays (9-11), caudal fin rays (16) and branchiostegal rays (3), the variations between two strains were observed merely. Siddique *et al.* (2007) described the number of dorsal fin spines ranging from 16 to 17, dorsal fin soft rays from 11 to 15, pectoral fin soft rays 15, pelvic fin spines 1, pelvic fin soft rays 5, anal fin spines 3 and anal fin soft rays from 8-11 in *Oreochromis niloticus* which is almost similar to the present findings. Notable variation was observed in case of scale above and below the lateral line between GIFT and GIFU. The range of the scales above lateral line was 4.5-5.5 in both GIFT and GIFU but greater number of individuals of GIFU contained 5.5. In case of scales below lateral line the range of GIFU (11.5-15.5) was greater than the range o f GIFT (10.5-11.5).

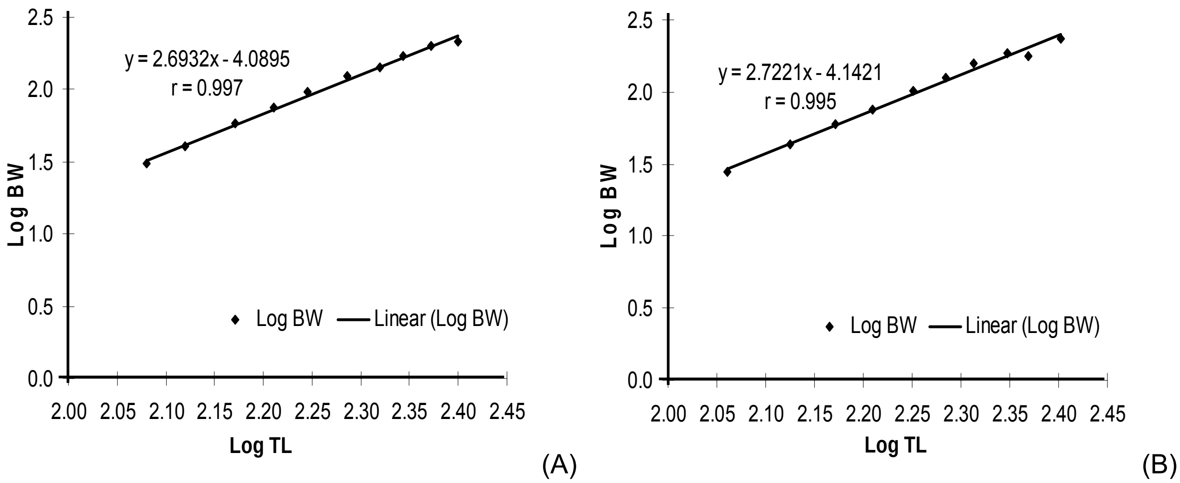

Fig. 3. Logarithmic relationship between total length and body weight of (A) GIFT and (B) GIFU.

The length-weight relationship of GIFT and GIFU (Fig.3) was not significantly different ($P<0.05$). The regression equation is expressed as:

LogBW (GIFT) = 2.6932 LogTL - 4.0895
LogBW (GIFU) = 2.7221 LogTL - 4.1421

The value of exponential in the length-weight equation was found to be 2.6932 and 2.7221 for GIFT and GIFU respectively which were within the range from 2.0 to 4.0 mentioned by LeCren (1951). Various workers calculated the values of regression coefficient (b) in different fish species and found the value of b is greater than 3. Narejo *et al.* (1999) and Al-Baz and Grove (1995) calculated value of regression coefficient b in *Tenualosa ilisha* (3.0246 for males and 3.0345 for females) and (2.68 for males and 3.16 for females) respectively. Azadi and Naser (1996) reported the values of regression coefficient to be 3.16 for males and 3.20 for females in *Labeo bata* and Quddus (1993) reported value of regression coefficient to be 3.40 in *Gudusia chapra* from Bangladesh. Hile (1936) and Martin (1949) observed that the value of regression coefficient (b) usually lies between 2.5 and 4.0 in cisco, *Leochthys artedi*. However, a variation in 'b' value may occur due to species variation, strain variation, stock variation, differences in environmental factors, sex variation etc.

The values of condition factor (K) were found to vary from 1.343-1.871 for GIFT and 1.385-1.825 for GIFU and the mean values were 1.671 and 1.711 for GIFT and GIFU accordingly. The values of relative condition factor (Kn) ranged from 0.897-1.06 for GIFT and 0.876-1.097 for GIFU and the mean values were 1.001 for GIFT and 1.002 for GIFU. Higher value of condition factor (K) and relative condition factor (Kn) expressed the robust character of GIFU individuals over GIFT ones during the study period.

Conclusion

Strain GIFU showed faster linear growth on maximum and minimum body circumference along with body depth whereas strain GIFT showed faster linear growth on standard length and head length. Notable variations were found in case of scales above and below the lateral line. Condition factor and relative condition factor were found higher in GIFU during the study period. For further study, genetic level works like allozyme electrophoresis, DNA based markers *i.e.* microsatellite, PCR- RFLP, RAPD etc. should be conducted to identify the actual reason of such variations.

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