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Growth Performance of Two GIFT Strains of Nile Tilapia *Oreochromis niloticus* Reared under Semi-Intensive Culture

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ABSTRACT

Genetically improved farm tilapia (GIFT), is derived through selective breeding from Nile tilapia (*Oreochromis niloticus*) which is native to Africa, has been adopted as an important aquaculture fish worldwide in last few decades. Selection of the suitable strain for farming is always a critical decision for farmers. The purpose of the present study was to compare the growth performance of two GIFT strains (GIFT-Th, imported from Thailand; GIFT-Tw, obtained from a local hatchery) in two earthen ponds, fed with commercially available feed. Similar feeding regime and physical conditions were maintained for both treatments. It was found that there was no significant difference in final total length (TL) and standard length (SL) of the fish in both treatments (P>0.05). However, average monthly weight gain, final total wet weight (WW) and weight gain with increase in TL were higher in GIFT-Th as compared to GIFT-Tw (P<0.05). There was no significant difference in FCR, SGR and K values measured for both treatments (P>0.05). These findings suggested that GIFT-Th has better genetic factors for weight gain as compared to GIFT-Tw, and should be preferred for farming, however an economic analysis for both strains determining benefit to cost ratio is pre-requisite before final recommendations.

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Z designed the study. NA collected and analyzed the data and wrote the article.

Key words
GIFT, Nile tilapia, Growth performance, FCR, SGR, K.

INTRODUCTION

Nile tilapia (*Oreochromis niloticus*) is among the most popular farmed fish species over the world, comes only after the carps in supplying good quality protein food (FAO, 2012). Due to its adaptability to wide range of conditions and good acceptability among consumers it is the prime culture species for saline, arid and semi-arid conditions of Pakistan (Mateen and Ahmed, 2015). Tilapia is being cultured over the world in different settings according to cultural and socio-economic conditions (Gupta and Acosta, 2004a), semi-intensive and intensive pond culture are the most adapted systems of tilapia culture by most of the farmers in Pakistan. All male culture is usually preferred over mixed sex culture to minimize the yield loss due to high reproductive rate of the fish.

As tilapia culture is becoming more intensified to get greater yields from less area available, as is the case with most of the farmers here in Pakistan, the input to output ratio may rise due to high cost of fish feed. Hence, selection of an optimal aquaculture species becomes extremely important to make farming more sustainable for small scale farmers.

Aquaculture production can be increased through selective breeding (Gjedrem *et al*., 2012) so, in recent past GIFT have been produced by selective breeding over many generations, which show better growth performance and help to maintain optimal benefit to cost ratio (Gupta and Acosta, 2004b; Ponzoni *et al*., 2011). But growth performance of any fish population can vary and pedigree of the fish is highly determinant of its live weight gain (Ponzoni *et al*., 2005). In Pakistan the GIFT strain is being imported from Thailand since 2010, now some local hatcheries have also started to provide GIFT seeds for aquaculture. Lack of information on complete understanding of fish being cultured would negatively impact aquaculture development of Pakistan. Therefore, the purpose of the study was to assess the growth performance of two genetically improved strains of Nile tilapia (*Oreochromis niloticus*) labeled as GIFT-Th (imported from Thailand) and GIFT-Tw (obtained from Tawakkal Fish Hatchery, Muzaffargarh) in semi-intensive mono-sex culture in earthen ponds.

MATERIALS AND METHODS

The fingerlings of GIFT (*Oreochomis niloticus*) were stocked in earthen ponds. Before stocking the ponds were drained and dried to remove the aquatic weeds and were limed and fertilized at an equal rate. The fingerlings

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of both species were acclimatized in cemented tanks for 10 days before stoking in experimental ponds. Each of the two earthen ponds were stocked by 2000 fingerlings. Before stocking, initial values of mean morphometric characteristics such as wet weight (WW), standard length (SL) and total length (TL) were recorded for each strain. These morphometric characteristics in terms of increased wet weight (g), increased standard and total lengths (cm) were also recorded on monthly basis to evaluate the growth performance of experimental fish during six months of experiment period from July 2015 to December 2015.

Specific growth rate (SGR) was calculated by the formula used by Cook *et al*. (2000).

$$SGR = \frac{\ln(\text{final weight}) - \ln(\text{initial weight})}{\text{Number of experimental days}} \times 100$$

Feed conversion ratio (FCR) was calculated by the formula used by Ridha (2000).

$$FCR = \frac{\text{Feed given (dry weight)}}{\text{Body weight (wet weight)}}$$

The value of condition factor (K) was calculated by formula given by Avsar (2005).

$$K = \frac{W \times 1000}{L^3}$$

Where, W is wet fish body weight and L is wet fish total length.

Physicochemical parameters of the pond water like total hardness, temperature, pH, DO etc. were determined on weekly basis in order to maintain similar conditions in both ponds. Oryza feed was obtained from Oryza Organics® Pvt. Ltd., with following proximate composition: crude protein, 30.0% (minimum); crude fat, 6.2% (maximum); crude fiber, 6.0% (maximum); moisture, 10.0% (maximum) and ash, 7.2% (maximum). The feed was used as per the directions provided by the manufacturer (Oryza Organics® Pvt. Ltd.) at the rates of 15.0% of body weight for a fish of 1-5g, 12.0% for 6-15g, 9.0% for 16-10g, 6.0% for 31-50g, 5.0% for 51-80g, 4.0% for 81-100g, 3.0% for >100g and 2.5% of body weight for a fish of >350g.

Data obtained were compiled and statistically analyzed by using statistical software packages SPSS® version 17. Analysis of variance (ANOVA) and Duncan multiple range test were used to compare the means and fit line regression model was used to determine the relationship between TL increase and WW gain in the fish.

RESULTS AND DISCUSSION

It was observed that GIFT-Th strain showed better growth as compared to GIFT-Tw, however there was no significant difference in terms of gain in total length (TL) and standard length (SL) of both the fishes (P>0.05), but gain in wet weight (WW) was significantly higher in GIFT-Th (P<0.05) (Table I).

Table I.- Comparison of initial and final values of morphometric components for both fishes.

		Initial value	Final value
TL (cm)	GIFT-Th	2.0±0.01a	27.1±2.5a
	GIFT-Tw	2.0±0.02a	26.4±1.7a
SL (cm)	GIFT-Th	1.7±0.03b	24.0±3.3b
	GIFT-Tw	1.7±0.01b	22.4±1.9b
WW (g)	GIFT-Th	0.55±0.05c	504.3±3.9c
	GIFT-Tw	0.49±0.06c	406.2±2.7d

Means within a column with same letter are statistically non-significant (P>0.05).

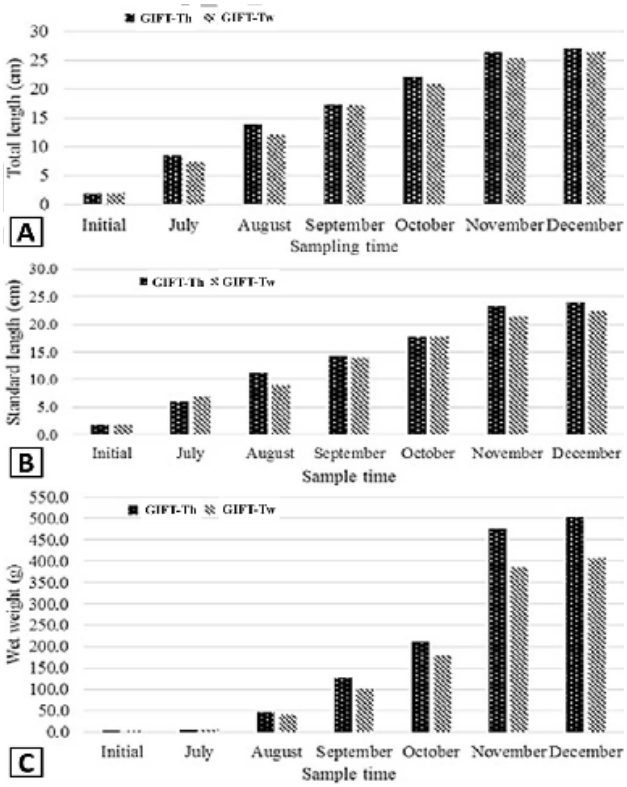

Fig. 1. Comparison of TL (cm) (A) SL (cm) (B) and WW (g) (C) in both fishes throughout trial period.

The rate of growth in terms of WW gain was higher in GIFT-Th from very initial stages of the trial as shown in Figure 1, however, increase in TL and SL showed similar pattern throughout the trial for both strains.

The Fit Line Regression model depicted that there was greater increase in WW for every unit increase in TL in

GIFT-Th as compared to GIFT-Tw. Following regression equations were calculated for GIFT-Th and GIFT-Tw, respectively:

$WW=-204.4+22.97\times TL$ ($R^2=83.6\%$; CI = 95%)

$WW=-149.6+18.80\times TL$ ($R^2=81.2\%$; CI = 95%)

There was no significant difference observed between FCR, SGR and K, for both the strains (P>0.05) (Table II). Moreover it was observed that the values of FCR and K remained similar throughout the trial (P>0.05), except in case of GIFT-Th the value of K was significantly lower in first two nettings (P<0.05). Monthly comparison of SGR showed that growth rate was maximum at the beginning of the trial and it continued to decrease in each successive netting (P<0.05) (Table III).

Table II.- Comparison of FCR, SGR and K for both fishes.

	GIFT-Th	GIFT-Tw
FCR	0.08±0.13a	0.08±0.15a
SGR	3.77±2.8b	3.72±2.8b
K	2.13±0.7c	2.18±0.7c

Means sharing common letters in a row are statistically non-significant (P>0.05).

Table III.- Monthly comparison of FCR, SGR and K values in both fishes.

	FCR		SGR		K	
	GIFT-Th	GIFT-Tw	GIFT-Th	GIFT-Tw	GIFT-Th	GIFT-Tw
July	0.01±0.0a	0.01±0.0a	8.04±0.4a	8.41±0.7a	1.12±0.5a	1.66±0.7a
August	0.02±0.0a	0.02±0.0a	6.73±0.1b	6.35±0.1b	1.81±0.4a,b	2.66±1.3a
September	0.03±0.0a	0.03±0.0a	3.26±0.0c	2.92±0.1c	2.57±0.8a,b	2.11±0.8a
October	0.04±0.0a	0.03±0.0a	1.74±0.0d	1.90±0.0d	2.03±0.7b	2.02±0.4a
November	0.02±0.0a	0.02±0.0a	2.69±0.0e	2.55±0.0c	2.62±0.5b	2.40±0.5a
December	0.37±0.0b	0.41±0.0b	0.20±0.0f	0.18±0.0e	2.61±0.7b	2.24±0.4a

Means sharing same letters within a column are statistically non-significant (P>0.05).

Table IV.- Physico-chemical parameters recorded fortnightly in pond 1 and 2.

Fortnight No.	pH	Temp. (°C)	DO (ppm)	CO_2 (mg/L)	Hardness (mg/L)	Conductivity (ms)	Salinity (ppt)	Alkalinity (mg/L)	TDS (mg/L)
Pond 1									
1	8.90	30.3	4.5	0	240	6.33	3.1	1200	3772
2	8.80	33.5	6.1	0	210	6.89	2.6	1140	3200
3	9.01	30.0	6.1	0	210	5.41	2.6	1220	3208
4	8.88	31.0	6.7	0	220	5.67	2.7	1230	3304
5	8.90	31.5	5.7	0	240	5.7	2.8	1240	3298
6	8.65	32.2	8.01	0	220	5.4	2.6	1260	3140
7	9.00	31.5	5.9	0	240	5.53	2.8	930	3353
8	8.90	24.8	8.1	0	360	5.6	2.8	1260	3357
9	8.80	24.9	6.2	0	340	5.4	2.7	1380	3320
10	8.60	18.7	6.4	0	360	5.2	3.1	1140	3113
11	8.80	13.9	10.5	0	280	5.1	2.8	920	3152
12	8.70	12.8	8.5	0	295	5.2	2.7	960	3260
Pond 2									
1	9.02	30.4	4.9	0	210	6.55	3.6	1350	4300
2	9.02	33.6	6.02	0	210	6.91	2.6	1260	3230
3	8.69	32.4	5.9	0	220	5.7	2.7	1320	3240
4	8.8	31.6	6	0	210	5.67	2.7	1230	3350
5	8.7	31.2	5.7	0	220	5.4	2.6	1340	3200
6	8.6	32.4	5.8	0	210	5.4	2.5	1370	3230
7	9	30.9	5.6	0	210	5.63	2.6	1220	3200
8	8.93	24.7	5.89	0	220	5.9	2.8	1338	3350
9	8.8	24.8	7.7	0	320	4.9	2.9	1240	3236
10	8.7	18.6	6.8	0	340	5.2	2.8	1180	3133
11	8.6	13.6	8.5	0	220	5.3	2.7	1220	3120
12	8.7	12.9	6.5	0	295	5.4	2.8	1240	3230

Figure 2 shows that identical trend of weight gain was present in both fishes, where maximum weight gain was achieved during October and November, and minimum gain was observed from November to December. Whereas the different physico-chemical parameters measured remained similar in both the ponds (Table IV).

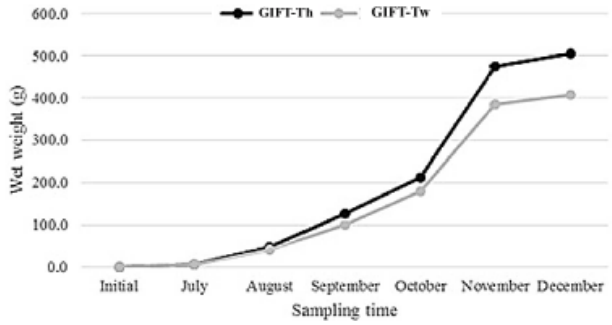

Fig. 2. Trend of increase in WW (g) in both fish species throughout the trial period.

The difference in growth in terms of weight gain observed in this study might be associated with possible genetic diversity present among the two populations, as was reported by Ponzoni *et al*. (2005) within GIFT populations of Malaysia. Many studies have reported the genetic correlation of growth in different strains of tilapia. The findings of Nguyen *et al*. (2010) emphasized the influence of genetic variability on weight gain of GIFT strain of tilapia. Luan *et al*. (2008) also described that the harvest weight of GIFT strain of tilapia is the product of interaction between environment and the genotype of the fish. Similar findings were also presented by Charo-Karisa *et al*. (2006) and He *et al*. (2015) for Nile tilapia (*Oreochromis niloticus*), they demonstrated that the heritability of both body weight and survival rate of the fish.

There was no significant difference in mean FCR, SGR and K values obtained from both ponds that may be due to the similar environmental conditions present in both ponds throughout the trial period. Initial uplift and gradual decline in SGR observed in studied populations can be attributed to fast metabolic rate of the fish at early age as compared to its body size which kept on declining in later part of the age. These findings are in accordance with the findings of Murawska (2012) who reported that the age related variations in the growth rate of animals do exist, but this needs to be further investigated in case of GIFT strain of Nile tilapia.

In present study monthly weight gain was variable through the trial it was observed that maximum weight gain in both fishes was achieved during the months of October and November when average water temperature was around 24°C, it can be inferred by these findings that this is the optimum temperature for tilapia growth. Then there was a sharp decline in weight gain during the month of December when average water temperature was around 13°C. It shows that the growth performance of GIFT tilapia is not suitable at colder water temperatures. Similar conclusion was made by Santos *et al*. (2013); they suggested that tilapia shows best growth performance between 21-24°C. Similarly, Atwood *et al*. (2003) reported that at lower temperature survival rate of Nile tilapia significantly decreases. So decreased growth rate of fish during the month of December may be due to deteriorated health condition of the fish and the fish might have started dying if it was not harvested at the end of sixth month.

CONCLUSION

Overall these findings suggest that from two genetically improved strain of tilapia GIFT-Th performed comparatively better in almost all the parameters measured for this study as compared to the strain that is managed and supplied by a local supplier, GIFT-Tw. There may be contamination of genetically unimproved tilapia at maintenance and brooding sites of said local hatchery or the local population needs to undergo further selection to attain genetic purity. Secondly, there may be incomplete sex reversal that caused overall low performance because some fishes may have spent their energies in gametes production. However further studies needs to be done to find out the exact cause of lower growth performance of locally available fish seeds. Moreover, a careful economic analysis for both strains determining benefit to cost ratio is mandatory before final recommendation of any strain for farming.

Statement of conflict of interest

Authors have declared no conflict of interest.

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