GROWTH PERFORMANCES FOR SELECTED AND UN-SELECTED LINES OF NILE TILAPIA (*OREOCHROMIS NILOTICUS*)

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Abstract

The growth performance and survival rate for selected and un-selected lines of Nile tilapia *(Oreochromis niloticus)* from base population formed from three different collected populations (Abbassa, Kafr- El - Sheikh and Aswan) were evaluated. At the end of growing period (120 day), in earthen ponds, the first selected generation (S1) and second selected generation (S2) lines showed the highest weight production (47.13 kg. and 62.52 kg per pond respectively), while control line for first generation C1 and control line for second generation C2 were the lowest weight production (30.47 kg. & 40.54 kg per pond respectively).

The survival rate (SR) of the first generation (S1) and second generation (S2) was (67.5 and 79.87 % respectively) compare to the control C1 & C2 (58.9 & 73.2 % respectively). On the other hand, the genetic gain per generation for the second selected generation S2 (43.68%) was higher than that of the genetic gain of the first selected generation S1 (43.48%).

That is to say, selective breeding program can be established as method in aquaculture for genetic improvement of fishes with regard to better growth rate and survival rate.

Key words: Selection, growth performances and survival rate, *Oreochromis niloticus.*

INTRODUCTION

Tilapias are widely recognized as one of the most important fish species for freshwater aquaculture in a wide range of farming systems from simple small-scale waste-fed fish ponds to intensive culture systems (Pullin, 1985). Among the wide variety of tilapias, Nile tilapia *Oreochromis niloticus* is the most common fish species in aquaculture. The natural genetic resources of tilapias are restricted to Africa. The Nile tilapia stocks used in Asian aquaculture seem to be descendants of a few introductions of small numbers of fish, mostly through intermediate un-tropical countries, and probably suffering from genetic founder and bottleneck effects (Pullin and Capili, 1988).

Genetic improvement programs can increase the productivity of cultured aquatic species (Hulata, 2001). Genetics played a very vital role to enhance production in aquaculture as well as fish culture. The purpose of selection of cultivated species, besides for better growth and survival is to develop resistance strain to various adverse environmental factors especially to variations in the temperatures, decreased oxygen levels in the medium, fluctuations in the level of pH

and against other pollutants. Tilapia can survive in low dissolved oxygen and high ammonia levels for longer periods than most other fish. They can be grown at densities greater than virtually any other kind of fish. These characteristics make them ideal for farming conditions (Kevin 1997).

The growth rate of tilapia in various production systems is a critical factor to the success of any aquaculture effort. Scientists and farmers are constantly trying to improve the growth rate of Tilapia by providing better nutrition, environmental conditions, or by altering the genetic capabilities of the organisms (Kevin 1997). Eknath *et al.* (1993) evaluated the growth performances of eight different populations of Nile tilapia (*Oreochromis niloticus*) in eleven different farm environments, Philippines, Egypt, Ghana, Kenya, Senegal, Israel, Singapore, Taiwan and Thailand populations. The results indicate highly significant differences among the growth performance of all populations. Egypt population was the fastest growing populations and Ghana was the lowest in the first generation. In the second generation, Kenya population emerged as the fastest growing populations and Ghana was the lowest. In Bangladesh Mazid *et al* (1996) reported that Genetically Improved Farm Tilapia (GIFT) populations had a better growth rate than indigenous populations after 3 months. Selective breeding is the only established method in aquaculture till now for genetic improvement of fishes with regard to better survival, growth, resistance to disease, adverse environmental factors and meat quality as demonstrated in the case of Genetic Improvement of Farmed Tilapias (GIFT).

This study aimed to compare growth performance and survival rate of selected and un-selected lines of Nile tilapia *Oreochromis niloticus.* The first (S1) and second (S2) generations were selected from base population of parents collected from three different location in Egypt (Abbassa, Kafr-El -Sheikh and Aswan).

MATERIALS AND METHODS

This paper is part of a long term project on the further genetic improvement of Nile Tilapia *(Oreochromis niloticus),* and it represents an early stage in the development of improved Nile Tilapia. As such, they should not be viewed as definitive, but only as indicative of futures that appear to begin emerging.

I- Origin of fish stocks:

Selected line consists of 42 females (43.1- 44.6 g) and 21 males (96.1-105.4 g) of *Oreochromis niloticus* as parents were received from World Fish Center, Abbassa (WFC) as part of a project titled (Transfer of selective breeding (GIFT) technology for aquaculture improvement from the Philippines to Sub-Saharan and Egypt) in contribution between World Fish Center and Central laboratory for Aquaculture

Research Abbassa, Egypt. The project was funded by the United Nations Development Program (UNDP).

Broodstock: selective fish were received from World Fish Center (Abbassa regional station) from a base population formed from three collected population from different locations (Abbassa, Kafr-El Sheikh and Aswan) starting from June 6, 2004. The broodstocks mated and produced the first generation (S1) in the spawning season of 2004, which in turn produced the second generation (S2) in 2005.

II- Fish Spawning and Nursing:-

Fish were spawned started from 6/6/2004 until 27/6/2004, the fries of first generation (S1) were collected and nursed in nursery hapas (mesh pore 1 mm), 200 fry in each hapa. After 25 day until 22/7/2004, 100 fish were transferred to B-net hapas (mesh pore 3 mm) for 30 days until 22/8/2004. Hapas were submerged in concrete tanks.

III- Stocking of the first generation:-

Selected first generation (S1) and normal fish control (C1) from Abbassa farm were stocked in earthen ponds as follows:-

Pond No	Date of stocking	Fish Type	Number of fish	Av. weight
2	15/8/04	C1	1500	2g
3	22/8/04	S1	1400	1.8g
4	22/8/04	S1	1400	1.6g
5	15/8/04	C1	1500	2g
6	22/8/04	C1	1500	1.6g
7	22/8/04	S1	1400	1.4g

Fish start feeding in pond (1000 m^2) on August 24 by using feeding pellets 25% protein. Fish were harvested from December 20 to Dec. 26, 2004 and the evaluation of growth performances of first generation (S1) and control (C1), (Abbassa farm) was carried out.

After evaluation of growth and survival rate of first generation (S1) and control C1 fish were stocked in two separate earthen ponds to the second season.

Broodstock: Selective first generation (S1) were harvested from earthen pond and control fish from Abbassa farm starting from May 1, 2005 At harvest time, 20% of mature fish were randomly selected from (S1) which had a better growth rats to form the parents to the second generation.

IV- Fish Spawning (S1) and Nursing:-

Fish (parents of S1) were spawned starting from 1/5/2005 until 1/6/2005, the fries of second generation (S2) were collected and nursed in nursery hapas (mesh

pore 1 mm), 200 fry in each hapa. After 25 day until 25/6/2005, 100 fish were transfer to B-net hapas (mesh pore 3 mm) for 25 days until 20/7/2005. Hapas were submerged in concrete tanks.

V- Stocking of the second generation (S2):-

Selected of the second generation (S2) and normal fish (C2) from Abbassa farm were stocked in earthen ponds as follows:-

Pond No	Date of stocking	Fish Type	Number of fish	Av. weight
2	20/7/2005	C2	1500	1.15g
3	20/7/2005	S2	1500	1.12g
4	20/7/2005	S2	1500	1.10g
5	20/7/2005	C2	1500	1.20g
6	20/7/2005	S2	1500	1.08g

Fish of the second generation (S2) started feeding in earthen ponds (1000 m^2) on 24, July 2005 by using feeding pellets 25% protein. Fish were harvested in December, 2005 and evaluated for growth performance of the second generation (S2) and control (C1) was done.

The ecological conditions of water of Abbassa farm: -

Temperature	29.88 ± 0.52 C°
Oxygen	9.55 ± 0.55 ppm
Alkalinity	332.5 ± 89.97 mg/L
NO_2	0.009 ± 0.00 mg/L
NH_4	0.03 ± 0.002 mg/L

The tested water quality parameters were within the acceptable ranges for tilapia culture

VI- Statistical analysis:-

Statistical analysis (Mean and Standard deviation) of the growth performance and survival rate data for each group was analyzed according to Snedecor, (1971).

Response to selection = ((ADWG2-ADWG1)/ADWG1)*100

Where: - ADWG1= average daily weight gain of control

ADWG2= average daily weight gain of selected.

RESULTS AND DISCUSSION

A- Growth performance

The growth rates in earthen ponds production systems is a critical factor to success any aquaculture effort. The growth performances of control C1 & C2 (from Abbassa farm), selected lines first and second generation (S1 & S2) in earthen ponds

(1000 m2) through growing periods are illustrated in table 1, 2, 3 & 4. At the end of experiment (120 days) the results showed that the first generation (S1) and second generation (S2) were the highest in weight harvest (47.13±12.58 kg and 62.52±11.87kg per pond respectively), while control C1 and control C2 showed the lowest in weight harvest (30.47±5.3 kg. & 40.54±12.96 kg per pond respectively). This result agrees with Eknath *et al.* (1993) who found that highly significant differences among the growth performance of all *Oreochromis niloticus* populations. Egyptian population was the fastest growing populations and Ghana was the lowest in the first generation. In the second generation, Kenya population emerged as the fastest growing populations and Ghana was the lowest. While, Elghobashy and Farag (2002) reported that the growth rates of 16 different crossing of Nile tilapia populations showed that the hybrid of Abbassa x Maryout was the highest in weight gain of 80.40 g, average daily weight gain of 1.34 g / day and final weight was 85.019±17.4 g.

Males were always growing faster than females by about 16%. The advantage of produce all male population is the greater growth rate of male, as well as the prevention of reproduction and the consequently over-crowding in ponds (Ponzoni *et al.*, 2005). In the present study, males growing faster than female in both selected generation, of the selected first generation (S1) fish showed that, the average daily weight gain 0.45 ± 0.02 and final weight 56.07±1.68 g was more than female, which had an average daily weight gain of 0.35 ± 0.04 and final weight gain of 43.58 ± 4.59 g. Also, the male of the second generation (S2) showed an average daily weight gain and final weight were 0.48 ± 0.07 & 59.42 ± 9.97 g. respectively compare to the female of the same generation, (0.37± 0.04 & 45.02 ± 4.21 g. respectively). While the control fish showed different growth rate lower than the selected lines, the control female fish (C1) had an average daily weight gain and final weight (0.25 ± 0.09 & 33.00+11.22 g. respectively) compare to the male fish (0.31 ± 0.07 & 40.49+9.21 g. respectively). Also, at the control of second generation (C2) the female fish was lower weight than male, the female fish had an average daily weight gain and final weight of (0.27± 0.07 & 33.8+9.31 g. respectively), while the male had (0.32 ± 0.10 & 39.91+13.44 g. respectively) for the same growing period.. This result agrees with Farag, *et al.* (2003) who showed that body weight gain in male of Nile tilapia, *Oreochromis niloticus* (44.03 ± 5.75g) was higher than that of female (34.72 ± 4.46g) in fish fed for 120 days and average daily weight gain in male and female fed for 60 days were 0.418 ± 0.12g & 0.340 ± 0.1 g, respectively. While, average daily weight gain increased in male and female fed for 120 days (0.367 ± 0.05 g & 0.289 ± 0.04 g, respectively). While, Bentsen *et al.*, (1998) reported that body size at harvest were

slightly stronger in the complete diallel cross of the eight strains of Nile tilapia *(Oreochromis niloticus*). The strains represented four wild populations collected from various locations in Africa and four populations that had been reproduced over a large number of generations for tilapia farming in Asia. Also, Hussain *et al.* (2002) used selective breeding techniques for stock improvement of silver barb (*Barbodes gonionotus* Bleeker) collected from wild caught populations, Thailand, Indonesia and Bangladesh. The base population was produced through a complete 3x3 diallele crossing experiment to produce nine heterogeneous (F_1 generation).The best three progeny groups were selected from each family and grown until maturity in ponds. At harvest, 20% of mature fish were mass selected from F_1 communal crossbred group and mated to produce the F_2 generation, mass selection was performed, selected 15% of the best mature breeders from F_2 generation to produce the third generation (F_3 generation). In each generation, evaluation of growth performance was carried out through comparative trials between selected and un-selected control (existing stock of Bangladesh). The weight gain values of the third generation (F_3 generation) of the selected group showed 21.9% superiority over the un-selected control.

B- Survival rate (%)

The survival rates (SR) of the first generation S1, second generation S2 , control C1 and control C2 from Abbassa farm of *Oreochromis niloticus*, were compared through 120 days growing period in earthen pond are shown in table 1,2,3 & 4. The results showed that, higher SR in the first and second generation (67.5±16.7 & 79.87±14.33 % respectively) compared to control C1 & C2 (58.9 + 16.37 & 73.2+0.85 respectively %)

The result agrees with Ebtehag (1999),at the first spawning and F1 hybrids, the survival rates for the first generation were different in all strain tested, the SR was high in all strains and their hybrids. It was 93% for Abbassa, 90% for Zawia, and 98% for Maryout. The survival rates for the hybrids were 91% for Abbassa x Zawia, 90% for Abbassa x Maryout and 95.2% for Maryout x Zawia. At the Second spawning generation (S2) and F2 hybrids, the survival rate (SR) was very high in all strains and their hybrids. It was 94% for Abbassa, 88.1% for Zawia and 90% for Maryout. The SR for the F2 hybrids was 89.5% for Abbassa x Zawia, 86.5 % for Abbassa x Maryout and 87.5 % for Zawia x Maryout.

C - Response to selection

Estimates of genetic gain per generation for aquatic animal species ranged from 10% to 20% (Gjedrem, 2000). In our case we may conclude that the genetic gain per generation for the second generation was (43.68%) was nearly equal to the genetic gain for the first generation was (43.48%). These results agree with Gall and

Bakar (2002) reported that the genetic gain was 40% in three generations. While, Ponzoni *et al.*, (2005) reported that response to selection in live weight between the 2002 and 2003 spawning seasons was of the order of 10%. This falls at the lower limit of the range, because of tag losses caused a lower selection intensity and loss of the identity of many potentially valuable fish.

The genetic stock improvement through genetic selection is one of the most useful ways of enhancing desirable traits in a founder stock with high genetic variability to reduce inbreeding in a population (Eknath *et al.*, 1998). In this study, the growth rate and survival rate were used to evaluate the selected fish lines of the first and second generation of *Oreochromis niloticus*, which were received from WFC and compared with control fish C1 & C2 from Abbassa farm.

Based on obtained results it could concluded that the selected first (S1) and (S2) generations showed the highest weight gain, while C1 and C2 controls recorded the lowest weight gain at the end of the growing period. Also, survival rates were high in the first S1 and second S2 generations and low in control C1 & C2. That is to say, selection program can by used to select a strain for better growth rate, survival rate and resistant to environmental stress which leas to subsequent increase fish production.

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Table 1. Growth rate of control (C1) Nile tilapia (*Oreochromis niloticus*).

No. Stock	AIW g	Harvest fish	Time Day	AFW M (kg)	AFW F(kg)	AFW Mixed	SR %	ADWG Male	ADWG Female	ADWG Mixed	TWPP Kg	TWPF Kg
1500	2	788	126	38.07	43.56	45.81	52.50	0.29	0.33	0.31	36.10	151.62
1500	2	764	125	50.67	34.22	42.45	46.70	0.39	0.26	0.32	29.76	124.97
1500	1.6	1100	123	32.75	21.22	21.98	77.50	0.25	0.16	0.21	25.57	107.38
Average	1.87	884.00	124.67	40.49	33.00	36.75	58.90	0.31	0.25	0.28	30.47	127.99
SD	0.23	187.45	1.53	9.21	11.22	12.90	16.37	0.07	0.09	0.06	5.30	22.28

Table 2. Growth rate of selected Nile tilapia S1 (*Oreochromis niloticus*).

No. Stock	AIW g	Harvest fish	Time Day	AFW M (kg)	AFW F(kg)	AFW Mixed	SR %	ADWG Male	ADWG Female	ADWG Mixed	TWPP Kg	TWPF Kg
1400	1.8	1182	118	57.47	45.96	51.71	84.40	0.47	0.37	0.42	61.12	256.72
1400	1.6	940	119	54.21	38.29	46.25	67.10	0.44	0.31	0.38	43.48	182.60
1400	1.4	714	124	56.52	46.50	51.51	51.00	0.44	0.36	0.40	36.78	154.47
Average	1.60	945.33	120.33	56.07	43.58	49.82	67.50	0.45	0.35	0.40	47.13	197.93
SD	0.20	234.05	3.21	1.68	4.59	3.10	16.70	0.02	0.04	0.02	12.58	52.82

Response to selection = 43.48 %

Table 3.Growth rate of control (C2) Nile tilapia (*Oreochromis niloticus*).

No. Stock	AIW g	Harvest fish	Time Day	AFW M (kg)	AFW F(kg)	AFW Mixed	SR %	ADWG Male	ADWG Female	ADWG Mixed	TWPP Kg	TWPF Kg
1500	1.15	1107	122.00	49.42	40.38	44.90	73.80	0.40	0.32	0.36	49.70	208.74
1500	1.20	1089	118.00	30.41	27.22	28.81	72.60	0.25	0.22	0.23	31.38	131.78
Average	1.18	1098.0	120.00	39.91	33.80	36.85	73.20	0.32	0.27	0.30	40.54	170.26
SD	0.04	12.73	2.83	13.44	9.31	11.37	0.85	0.10	0.07	0.09	12.96	54.42

Table 4. Growth rate of selected Nile tilapia S2 (*Oreochromis niloticus*).

No. Stock	AIW g	Harvest fish	Time Day	AFW M (kg)	AFW F(kg)	AFW Mixed	SR %	ADWG Male	ADWG Female	ADWG Mixed	TWPP Kg	TWPF Kg
1500	1.12	1263.0	124.00	70.87	42.66	56.76	84.20	0.56	0.33	0.45	71.69	301.10
1500	1.10	1373.0	119.00	54.74	42.52	48.63	91.53	0.45	0.35	0.40	66.77	280.44
1500	1.08	958.00	117.00	52.65	49.88	51.27	63.87	0.44	0.42	0.43	49.11	206.28
Average	1.10	1198.0	120.00	59.42	45.02	52.22	79.87	0.48	0.37	0.43	62.52	262.60
SD	0.02	215.00	3.61	9.97	4.21	4.15	14.33	0.07	0.04	0.02	11.87	49.86

Response to selection (RS) = 43.68 % L = Length W = weight M = male F = female

AIW = Average Intial Weight AFW = Average Finale Weight TWPF = Total Weight Production per Fadan SR = Survival Rate

TWP = Total Weight Production ADWG = Average Daily Weight gain TWPP = Total Weight Production per pond (1000 m^2)

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أداء النمولأسماك منتخبة وغير منتخبة من البلطى النيلى

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قسم الوراثة المعمل المركزى لبحوث الثروة السمكية ، العباسة، أبو حماد، شرقية.

يهدف هذا البحث إلى تقييم معدلات النمو والحياة لاسماك منتخبة وغير منتخبة من اسماك البلطى النيلى المجمعه من ثلاث مناطق من مصر (مزرعة العباسة ومنطقة كفر الشيخ وبحيرة ناصر باسوان) بعد تهجينهم والحصول على الاباء من المركز الدولى للاسماك فرع العباسة والحصول على الجيل الاول واستزراعه موسم ٢٠٠٤ وتقييم معدلا النمو والاحياء وانتخاب الافضل فى معدلات النمو والحصول على الجيل الثانى ٢٠٠٥ وذلك في خلال موسمي التربية في احواض ترابيه مساحة ١٠٠٠ متر مربع. وقد سجلت النتائج التالية:-

١- معدلات النمو خلال موسم التربية مرتفع جدا فى الجيل الاول المنتخبS1 والجيل الثانىS2 (٤٧,١٣ و ٦٢,٥٢ كجم لكل حوض على التوالى) عن المجموعة الضابطة الاولىC1 والثانيه C2 (٣٠,٧٤ و ٤٠,٥٤ كجم لكل حوض على التوالى) خلال ١٢٠ يوم استزراع وكانت معدلات النمو للذكور أعلى من الإناث.

٢- معدلات الأحياء بصوره عامه منخفض للمجموعة الضابطة الاولى والثانية (٥٨,٩ و ٧٣,٢ % على التوالى) عن معدلات النمو للجيل الاول والثانى المنتخب (٦٧,٥ و ٧٩,٨٧ % على التوالى).

٣- معدل الانتخاب اعلى للجيل الثانى (٤٣,٦٨ %) المنتخب عن الجيل الاول المنتخب (٤٣,٤٨ %).

يدل هذا على أن الانتخاب الوراثي هو من انسب الطرق المستخدمة للتحسين الوراثى للأسماك من حيث معدلات النمو والأحياء وتحمل الظروف البيئية.