Reproductive Performance and Early Growth of Three Strains of Nile Tilapia (*Oreochromis niloticus*) in Egypt: Abbassa, Kafr El Sheikh, and Manzala

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Abstract: The study compared some reproductive parameters and early growth performance in three Nile tilapia strains one of which have been improved concerning harvest weight and survival rate (Abbassa) and two non-improved local strains (Kafr El Sheikh and Manzala).A total of 100 females and 30 males from each strain were stocked into five separate hapas (3 X 8 X 1m). After 4 weeks conditioning phase five spawning cycles were conducted. Every spawning cycle 36 females and 12 males from each strain were selected and stocked into six spawning hapas (1 X 2 X 1m), each group contained two males and six females in order to determine some reproductive parameters. From the production of first spawning cycle 1000 fry were randomly selected from each strain and transferred to 12 hapas (3×4×1 m), four replicates of each strain at a stocking rate of 250 fry/hapa for a further growth period of 60 days. The local commercial strain Kafr El Sheikh showed superior ovary weight (g), gonado-somatic index (GSI), absolute fecundity, and relative fecundity (31, 41, 40, and 41% respectively) over the Abbassa strain. Manzala strain was also greater than Abbassa strain in gonado-somatic index (GSI), absolute fecundity, and relative fecundity (20, 22, and 25 % respectively). Fry number/female and fry number/g. female in Abbassa strain were lower than Kafr El Sheikh strain with 24.1 and 26.4% respectively and were also lower than Manzala strain with16.3 and 16.01% respectively. All studied reproductive parameters were significantly higher at June followed with May within 5 months experimental period. As for early growth performance final body weight and survival rate % of Abbassa strain were significantly ($P<0.01$) higher than those of Kafr El Sheikh and Manzala strains. Average daily gain (ADG) and condition factor were also significantly ($P<0.001$) higher in Abbassa strain than Kafr El Sheikh and Manzala commercial strains. In conclusion, Abbassa strain showed the lowest results in all reproductive parameters and the best in the early growth performance.

Keywords: Reproductive parameters, Fecundity, Fry production, Early growth, Selection.

INTRODUCTION

Cultivated tilapia production increased in Egypt exponentially between 2003 and 2014, from 200,000 to 759,601 metric tons with an average growth near to 380% during the same period (GAFRD, 2004, 2014). Significant progress has been made in the previous decades concerning the implementation of genetic improvement programmes in species used extensively in aquaculture such as the tilapias and carps. Number of breeding programmes in tilapia has been conducted globally, the best known program was Genetically Improved Farmed Tilapia (GIFT) project which initiated by ICLARM (Eknath and Acosta, 1998). In Egypt, the WorldFish center conducted genetic improvement programme in Nile tilapia since 2002 to develop growth improved tilapia strain called as the Abbassa strain (Rezk *et al.,* 2009). The ninth generation of Abbassa strain has been introduced to the Egyptian aquaculture industry. Abbassa showed a superior on-station performance concerning harvest weight as compared to a widely and locally available commercial tilapia strain (Ibrahim *et al.,* 2013*)* while the reproductive performance of the selection strain Abbassa was accompanied with many criticisms from the hatcheries mangers. The proper selection of breeders has increasingly been one of the most important factors in the success of seeds production to meet the market requirements (Coward *et al.,* 2002; Bhujel *et al.,* 2007). Information about the relative performance of Abbassa in the reproductive traits and early growth performance can help in optimizing the use of such strain. The aim of this study was to evaluate the reproductive performance and early growth of Abbassa selection strain as compared with two local commercial strains (Kafr El Sheikh and Manzala) in order to characterize the sources that are currently the most cultivated in Egypt.

MATERIALS AND METHODS

Experimental condition

This study was carried out in a private fish hatchery from April to September 2016. The experiment was done into two earthen ponds (0.2 ha) supplied with filtered water from Al-Salam canal. Approximately 20% of the water was exchanged daily to maintain good water criteria. Water temperature ranged between 22.2 and 32.5°C, pH value ranged between 7.3-8, water salinity ranged between 2000-2700 mg/L, and water depth maintained at 150 cm within the experimental period

Experimental Fish

Terms line, strain, stock, and population are used interchangeably, any discrete breeding population from a hatchery may be termed a strain for evaluation purposes (Ponzoni *et al.*, 2013). This study involved three strains of Egyptian Nile tilapia: The selection strain Abbassa and two local commercial tilapia strains Kafr El Sheikh and Manzala. Abbassa selection strain has been described with Rezk *et al.* (2009) and Khaw *et al.* (2009). Abbassa strain was introduced from WorldFish Regional Center, Abbassa, Abu-Hamad, Sharkia, Egypt. Manzala local commercial strain was obtained from a civil tilapia hatchery, located at Manzala, Dakahlia, Egypt. Kafr El Sheikh commercial strain was obtained from a civil tilapia hatchery, located at Al-Ryad, Kafr El Sheikh, Egypt.

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Reproductive performance

A total of 100 females and 30 males from each studied strain were stocked into five separate hapas (3 × 8 × 1 m). After 4 weeks conditioning phase five spawning cycles were conducted within 5 months. Each month females and males were individually checked for their sexual readiness. Females were checked to readiness to spawn by visually examining their morphological characteristics. Females were considered to be ready when they have pink to red and protruding genital papilla, fully opened genital pore, and distended abdomen (WorldFish, 2004). 36 females and 12 males from each strain were selected as parents every spawning cycle. The selected parents were used to form 18 breeding groups into hapas (1 × 2 × 1 m), six hapas of each strain and each group contained two males and six females. After 15 days, swim-up fry were collected and then all females were checked and any eggs or fry still incubated inside the female's mouth were also collected and counted. A total of 30 females from each strain were used to determine ovary weight (g); Gonado-somatic index (GSI) which calculated according to the formula GSI = [weight of gonads (g.) / body weight (g.)] × 100 (De Vlaming *et al*., 1982); Absolute fecundity (AF) which determined as follow: F = (W / w) × X; where F is the absolute fecundity, W: the weight of gonad, w: the mean weight of sub-samples and X: the counted number of mature eggs in the sub-sample (Hunter *et al.,* 1992); Relative fecundity (RF) which determined as the total number of eggs per unit weight of fish (Hunter *et al*., 1992). The fry production performance was evaluated through counting the total produced fry or females had yolk sac fry or egg in her mouth. Fry number/female and Fry number / g. female were determined for each spawning hapa. Parents were fed 1.5% of their average body weight with a pelleted commercial feed containing 35% crude protein. Stocking and spawning hapas were checked, cleaned, and prepared if required after each spawning cycle.

Early growth phase

At the end of the first spawning cycle a total of 1000 fry were randomly selected from each strain and their initial weight and length mean were recorded. The selected fry were transferred to 12 hapas (3 × 4 × 1 m), four replicates of each strain at a stocking rate of 250 fry per hapa for a further growth period of 60 days. During the first nursery stage (4 weeks) fry were fed *ad libitum* four times per day with a commercial powder feed containing 45% crude protein. After such nursery phase fish were fed at 6% of their body weight with commercial pellet containing 35% crude protein. At the end of the experimental growth trial 50 fish per hapa were randomly collected and individually weighed (g) and their total body length (cm) measured. Condition factor was calculated according to the formula: K = [Weight (g.) / Length $(cm)^3$] × 100 (Le Cren, 1951). Average daily gain (ADG) was calculated as ADG = Total gain / Duration period (Ricker, 1975; Castell and Tiews, 1980). Survival rate (%) was calculated as = Number of fish at the end of the experiment / Number of fish at the start of the experiment × 100.

Statistical analysis

The data of the reproductive performance were statistically analyzed according to the following model: $Y_{ijk} = \mu + S_i + M_j + SM_{ij} + e_{ijk}$, where, μ is the overall mean, S_i is the fixed effect of i^{th} strain (i = 1 …3), M_j is the fixed effect of j^{th} month (j = 1 …5), SM_{ij} is the fixed effect of the interaction between strain and month, and e_{ijk} is random error. The data of early growth performance were statistically analyzed according to the following model: $Y_{ij} = \mu + S_i + e_{ij}$, where, μ is the overall mean, S_i is the fixed effect of i^{th} strain (i = 1 …3) and e_{ij} is the random error. All analyses were conducted using SPSS 22 (IBM SPSS, 2013) program. Means were tested for significant differences using Duncan's Multiple Range test (Duncan, 1955).

RESULTS AND DISCUSSION

Table (1) showed the morphometric characterization of the experimental strains that include body weight (g), total body length (cm), condition factor, and body girth (cm).

The results (Table 2) revealed that the body weight of the females from different strains within the 5 months spawning period didn't differ significantly. The ovary weight (g) was significantly ($P < 0.01$) higher in Kafr El Sheikh local strain (6.97 g) than that of Abbassa selection strain (5.15 g) while ovary weight in Manzala strain (6.04 g) didn't differ significantly from, both Kafr El Sheikh and Abbassa strains. Additionally, Kafr El Sheikh commercial strain showed a significantly ($P < 0.001$) higher gonado-somatic index (3.02) than that of another commercial strain Manzala (2.57) which in turns significantly higher than that of the selection strain Abbassa (2.14).

Table (1): Descriptive statistics for body measurements of broodstock of three different Nile tilapia strains

Strain	Males				Females			
	Length (cm)	Weight (g)	Condition factor	Girth (cm)	Length (cm)	Weight (g)	Condition factor	Girth (cm)
Abbassa	23.9	282.3	2.08	19.02	23.55	244.5	1.86	17.47
Manzala	24.8	292.9	1.94	19.01	23.2	246.1	1.96	17.51
Kafr El Sheikh	24.5	285.2	1.95	18.7	23.6	258.2	1.98	17.69

Table (2): Least squares means for reproductive parameters of three different Nile tilapia strains within 5 months experimental period

Effect	Female weight (g)	Ovary weight (g)	GSI	Absolute fecundity	Relative fecundity	Fry no./ Female	Fry no./ g. Female
Strain							
Abbassa	233.1	5.15^{b}	2.14^{c}	526.33^{b}	2.31^{b}	247.33^{b}	1.06$_{b}$
Manzala	231.8	6.04^{ab}	2.57^{b}	644.26^{a}	2.91^{a}	287.66^{ab}	1.23^{ab}
Kafr El Sheikh	231.5	6.97^{a}	3.02^{a}	740.21^{a}	3.28^{a}	307.16^{a}	1.34^{a}
S.E.	9.45	0.46	0.14	35.02	0.18	17.66	0.07
Significance	Ns	**	***	***	***	**	**
Month							
May	232.3	6.45^{ab}	2.73^{b}	673.16^{b}	2.94^{b}	313.3^{b}	1.35^{b}
June	227.8	7.73^{a}	3.34^{a}	82571^{a}	3.78^{a}	386.11^{a}	1.69^{a}
July	232.3	5.27^{b}	2.26^{b}	558.01^{b}	2.32^{b}	231.11^{c}	0.99^{c}
August	229.0	5.34^{b}	2.30^{b}	569.08^{b}	2.56^{b}	255.5b^{c}	1.11^{bc}
September	239.3	5.47^{b}	2.26^{b}	558.68^{b}	2.36^{b}	217.5^{c}	0.91^{c}
S.E.	12.2	0.59	0.18	45.21	0.24	22.81	0.01
Significance	Ns	**	**	***	***	**	***
Strain* Month							
Abbassa							
May	245.8	6.08	2.45	600.13	2.48	323.3	1.31
June	215.9	6.31	2.70	663.15	3.09	291.66	1.35
July	232.9	4.35	1.83	448.73	2.01	205	0.88
August	229.8	4.4	1.87	458.48	2.06	224.16	0.97
September	241.5	4.6	1.88	461.18	1.93	192.5	0.8
Manzala							
May	227.8	5.65	2.34	586.8	2.63	287.5	1.26
June	241.9	8.08	3.38	845.51	3.89	411.66	1.71
July	228.6	5.58	2.43	607.51	2.79	261.66	1.14
August	228.1	5.35	2.33	583.73	2.63	244.67	1.06
September	232.4	5.63	2.39	597.63	2.6	233.33	1
Kafr El Sheikh							
May	223.1	7.6	3.39	832.48	3.72	389.16	1.47
June	225.6	8.87	3.95	968.48	4.35	455	2.02
July	235.6	5.88	2.52	617.8	2.77	226.66	0.96
August	229.4	6.31	2.71	665.03	2.97	298.33	1.3
September	243.8	6.18	2.52	617.25	2.56	226.66	0.93
S.E.	21.1	1.03	0.31	78.31	0.41	39.51	0.17
Significance	Ns	Ns	Ns	Ns	Ns	Ns	Ns

$^{ab...}$ Within classification any two means having the same script are not significantly different using Duncan test $P \leq 0.05$

** Significant differences at $P < 0.01$; *** Significant differences at $P < 0.001$; Ns not significant differences

The results indicated that the absolute fecundity (AF) of both commercial strains Kafr El Sheikh and Manzala (740.21 and 644.26 respectively) were significantly ($P < 0.001$) higher than the absolute fecundity of the selection strain Abbassa (526.33). Similarly, the relative fecundity (RF) of the selection strain Abbassa (2.31) was significantly ($P < 0.001$) lower than those of Kafr El Sheikh and Manzala strains (3.28 and 2.91 respectively).

The results (Table 2 and Fig. 1) showed that the fry production expressed as fry number / female was significantly ($P < 0.01$) higher in the local commercial strain Kafr El Sheikh (307.16) than that of the selection strain Abbassa (247.33). Furthermore, the fry production performance as fry number / g. female was also significantly higher in Kafr El Sheikh (1.34) than Abbassa (1.06). Both fry number / female and fry number / g. female of the local commercial strain Manzala (287.66 and 1.23, respectively) didn't differ significantly from those of both another studied sources (Table 2; Figs. 1 and 2).

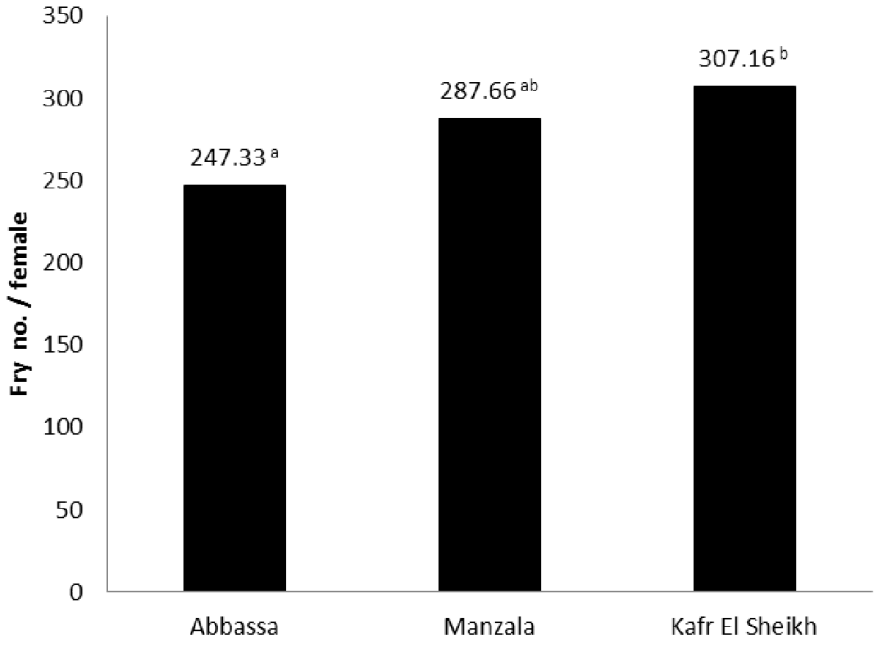

Fig. (1): Fry number / female of three Nile tilapia strains during 5 months experimental period.
Different letters labeling the data points indicate statistical differences among groups ($P < 0.05$)

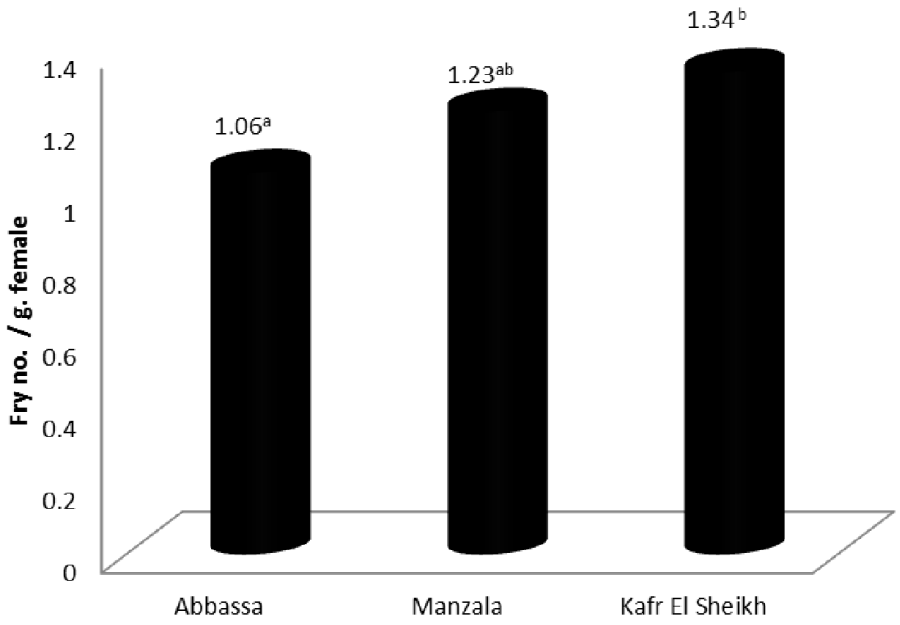

Fig. (2): Fry number / g. female of three Nile tilapia strains during 5 months experimental period
Different letters labeling the data points indicate statistical differences among groups ($P < 0.05$)

Reproductive performance of strains of Nile tilapia and other species have been compared (Little *et al.,* 1993; Ridha, 2004, 2010). Large variations in the reproductive patterns within and between the strains of tilapia have been reported (Macintosh and Little, 1995; Mair *et al*., 2004; Almeida, 2013). Many factors involved in the reproductive efficiency of tilapia (Kubitza, 2000; Little and Hulata, 2000*)*. Genetic inheritance was reported to be involved in determining the reproductive performance of tilapia (Coward and Bromage, 2000). Experimental Nile tilapia sources involved in the present study have a different genetic background as Abbassa strain described by Rezk *et al.* (2009) and by Khaw *et al.* (2009) as a selection strain produced from a base population consisted of four populations at 2002 and then undertaken into a selective breeding programme concerning harvest weight mainly, followed by survival rate while the another two experimental sources Kafr El Sheikh and Manzala were commercial local strains. The results indicated that the local commercial strain Kafr El Sheikh was significantly higher than improved strain Abbassa in ovary weight (g), gonado-somatic index (GSI), absolute fecundity (AF), and relative fecundity (RF) with 31, 41, 40 and 41% respectively. Additionally, another studied commercial strain Manzala was also significantly higher than the selection strain Abbassa in gonado-somatic index (GSI), absolute fecundity (AF), and relative fecundity (RF) with 20, 22 and 25% respectively. The relative performance of the selection strain Abbassa concerning fry number / female and fry number/g. female were lower than those of the commercial strain Kafr El Sheikh with 24.1 and 26.4%, respectively and lower than those of Manzala with 16.3 and 16.01%, respectively. These findings led to state that the studied reproductive traits were notably lower in the selection strain Abbassa than the two commercial populations Kafr El Sheikh and Manzala.

The impact of selection for growth on the reproductive performance, the presence or absence of a correlated response in sexual patterns in growth selection programmes represents a quit important research interest in order to optimize the practical use of the available strains. It seems that the genetic improvement for the harvest weight in Abbassa was accompanied with a notable depression in the reproductive patterns. These findings were relatively in agreement with Mair *et al.* (2004) who mentioned that the growth improved GIFT strain had significantly lower absolute and relative fecundity than another three studied strains. Furthermore, he reported that the local commercial strain Chitralada showed the highest ranked relative fecundity over three genetically improved strains. On the other hand, he noted that another selection strain named IDRC appear to have a positively correlated response in fecundity parameters. The present results were also in contrast with Azhar *et al*. (2016) who mentioned that female's reproductive performance of growth improved GIFT strain did not change as a consequence of selection for growth.

The results (Table 2) revealed that the female weights didn't differ significantly between different studied months. As for the ovary weight the highest ovary weight obtained in June (7.73 g) which was significantly ($P < 0.01$) higher than those in July, August, and September (5.27, 5.34 and 5.47 g respectively). The gonado-somatic index (GSI) was also highly significant ($P < 0.01$) in June (3.34) than those in May, July, August, and September (2.73, 2.26, 2.30 and 2.26, respectively). Similarly both absolute and relative fecundity were significantly ($P < 0.001$) higher in June (825.71 and 3.78 respectively) than May, July, August, and September (673.16 & 2.94; 558.01 & 2.32; 569.08 & 2.56; 558.68 & 2.36 respectively). Regarding the fry production as fry number / female and fry number / g. female, significant higher records ($P < 0.01$ and $P < 0.001$ respectively) were listed in June (386.11 and 1.69 respectively) than those in May (313.3 and 1.35 respectively) which in turns significantly higher than those of July, August, and September (231.11 & 0.99; 255.5 & 1.11; 217.5 & 0.91 respectively). The results (Table 2) indicated that the effect of interaction between strain and month was insignificant for all studied traits.

Water temperature is considered as one of the most important factors that influences the reproductive performance of tilapia (Msiska and Costa-Pierce, 1997; Fath El-Bab *et al*., 2011). The present results indicated that the reproductive performance traits that include ovary weight, gonado-somatic index (GSI), absolute fecundity (AF), relative fecundity (RF), fry number / female, and fry number / g. female were all higher at June followed with May within 5 months experimental period. Within May and June the water temperature ranged from 24.2 - 26.7Cº. These findings were in agreement with Kubitza (2000) who reported higher frequencies of spawning and post-larvae production over 24Cº. Additionally, Farag (2003) stated that the optimal reproductive performance of Nile tilapia occurs during the period from April to June. Fath El-Bab *et al*. (2011) also mentioned highest reproductive performance of two Egyptian tilapia populations during May and June. The noted decrease in all studied reproductive parameters during the following months (July, August, and September) may be results from the increase in the water temperature within this period (28.1 - 32.5Cº). The current results were relatively similar to Little and Hulata (2000) who reported that high temperatures (33 – 35Cº) reduce fecundity, spawning frequency, and egg quality in the Nile tilapia.

Concerning the fry growth performance, the results (Table 3) revealed that both initial weight and initial length didn't differ significantly between the experimental strains. Mohamed *et al*. (2014) reported a significant relationship between the female weight and the fry size. The indifferent female's weights (Table 2) in the present study may explain the similarity of the initial weight and length of the produced fry. The final weight of the selection strain Abbassa (8.97 g) was significantly ($P < 0.01$) higher than those of both

local commercial strains Kafr El Sheikh and Manzala (8.21 and 8.17 g respectively). Average daily gain (ADG) was significantly ($P < 0.001$) higher in Abbassa strain (0.149) than Kafr El Sheikh and Manzala (0.135 and 0.136, respectively). Additionally, the survival rate % was significantly ($P < 0.01$) higher in Abbassa strain (93.7 %) than Kafr El Sheikh (90.41%) and Manzala (89.58%).

Table (3): Least squares means for early growth performance of three different Nile tilapia strains within 60 days experimental period

Strain	Initial weight (g)	Initial length (mm)	Final weight (g)	Final length (cm)	Condition factor	ADG g/day	Survival rate %
Abbassa	0.0137	10.75	8.97[a]	6.51	3.23[a]	0.149[a]	93.7[a]
Manzala	0.0135	10.5	8.17[b]	6.52	2.94[b]	0.135[b]	89.58[b]
Kafr El Sheikh	0.0135	10.75	8.21[b]	6.61	2.86[b]	0.136[b]	90.41[b]
S.E.	0.0001	0.03	0.11	0.03	0.04	0.002	0.79
Significance	Ns	Ns	**	Ns	***	***	**

[ab] Within classification any two means having the same script are not significantly different using Duncan test $P< 0.05$.
** Significant differences at $P < 0.01$; *** Significant differences at $P < 0.001$; Ns not significant differences.

The final body weight of Abbassa selection strain after 60 days was higher than those of Kafr El Sheikh and Manzala with 9.25 and 9.79% respectively. Furthermore, Average daily gain (ADG) of Abbassa selection strain during the early growth phase (60 days) was higher than those of Kafr El Sheikh and Manzala strains with 9.5 and 10.3% respectively. As for survival rate Abbassa selection strain ranked first over another two sources. This notable superiority in the early growth patterns in Abbassa strain may be explained as a result of nine generations of selection for harvest weight. Our findings were compatible with Ibrahim *et al.* (2013) who found that Abbassa selection line outperformed the Kafr El Sheikh commercial strain in terms of growth rate with about 28% in the harvest weight. The higher survival rate in Abbassa strain during the early growth phase (60 days) may be explained as survival rate was involved secondly in the selective breeding program of Abbassa (Rezk *et al.,* 2009; Khaw *et al.,* 2009). The final body length didn't differ significantly between all studied strains. The condition factor of Abbassa strain (3.23) was significantly ($P < 0.001$) higher than those of Kafr El Sheikh and Manzala (2.94 and 2.86, respectively). These findings indicated a higher response in body weight than that of body length for selection procedures in Abbassa strain. These results were agreed with De Oliveira *et al.* (2016) investigation in Nile tilapia in which he reported small and slowly constant effect of selection process for growth rate in body shape traits, such effect results in more rotund fish.

CONCLUSION

The current study showed that Abbassa selection strain has an inferior reproductive performance and superior early growth performance as compared with Kafr El Sheikh and Manzala local commercial strains. These findings led to suggest that choosing the ideal strain should take into account the specific goals desired of the Egyptian hatcheries. Kafr El Sheikh and Manzala commercial strains will be more appropriate choice for seeds number production while Abbassa will be more adequate in order to producing heavier tilapia seeds.

REFERENCES

Almeida, D. B., M. A. P. da Costa, L. N. Bassini, C. I. P. Calabuig, C. G. A. Moreira, M. D. N. Rodrigues, H. J. Pe´rez, R. A. Tavares, A. S. Varela Jr. and H. L. M. Moreira (2013). Reproductive performance in female strains of Nile tilapia, *Oreochromis niloticus.* Aquaculture International, 21(6): 1291-1300.

Azhar, H., N. H. Nguyen, W. Mekkawy, H. L. Khaw, H. Y. Yee, K. R. Abu Bakar, R. W. Ponzoni and S. A. Mohd Nor (2016). Genetic parameters and correlated responses in female reproductive traits in the GIFT strain. Aquaculture Research, 47: 1488–1498.

Bhujel, R. C., D. C. Little and A. Hossain (2007). Reproductive performance and the growth of pre-stunted and normal Nile tilapia

(Oreochromis niloticus) broodfish at varying feeding rates. Aquaculture, 273: 71–79

Castell, J. D. and K. Tiews (1980). Report of the EIFAC, IUNS and ICES Working Group on the Standardization of Methodology in Fish Research. Hamburg, FRG, Germany, IFAC Tech. Pap, 24(3): 21–23.

Coward, K. and N. R. Bromage (2000). Reproductive physiology of female tilapia broodstock Reviews in Fish Biology and Fisheries, 10: 1–25.

Coward, K., N. R. Bromage, O. Hibbitt, and J. Parrington (2002). Gamete physiology, fertilization and egg activation in teleost fish. Rev Fish Biol. Fisher, 12: 33–58.

De Oliveira, C. A., R. P. Ribeiro, G. M. Yoshida, N. M. Kunita, G. S. Rizzato, S. N. de Oliveira, A. I. Dos Santos and N. H. Nguyen (2016). Correlated changes in body shape after five generations of selection to improve growth rate in a breeding program for Nile tilapia *Oreochromis niloticus* in Brazil. J. Appl. Genet., 57(4):487-493.

De Vlaming, V., G. D. Grossman and F. Chapman (1982). On the use of the gonado-somatic index. Comp Biochem Physiol., 73: 31–39.

Duncan, D. B. (1955). Multiple range and multiple F test. Biometrics, 11: 1- 42.

Eknath, A. E. and B. O. Acosta (1998). Genetic improvement of farmed tilapias (GIFT) project: Final report, March 1988 to December 1997. International Center for Living Aquatic Resources Management, Makati City, Philippines.

Farag, M. S. (2003). Reproductive performance of *Oreochromis niloticus* through three seasons on earthen ponds. Egypt. J. Aquat. Biol. & fish., 7(4): 263 – 282.

Fath El-Bab, A. F., M. E. Farag, A. A. Ramadan and A. S. Hassan (2011). Effect of temperature and female weight on reproductive performance of two Nile tilapia (*Oreochromis niloticus*) populations Egypt. J. Aquat. Biol. & Fish., 15 (2):179-193.

GAFRD (2004). General Authority for Fish Resources Development. Annual fishery statistics report, Ministry of Agriculture and Land Reclamation, Cairo, Egypt.

GAFRD (2014). General Authority for Fish Resources Development. Annual fishery statistics report, Ministry of Agriculture and Land Reclamation, Cairo, Egypt.

Hunter, J. R., B. J. Macewicz, N. C. Lo, and C. A. Kimbrell (1992). Fecundity, spawning and maturity of female Dover sole *Microstomus pacificus*, with an evaluation of assumptions and precision. Fish. Bull. US., 90: 101-128.

Ibrahim, N. A., M. Y. Abou Zaid, L. K. Hooi, G. O. El-Naggar and R. W. Ponzoni (2013). Relative performance of two Nile tilapia (*Oreochromis niloticus* Linnaeus) strains in Egypt: The Abbassa selection line and the Kafr El Sheikh commercial strain. Aquaculture Research, 44: 508–517.

Khaw, H. L., H. Bovenhuis, R. W. Ponzoni., M. A. Rezk, H. Charo-Karisa and H. Komen (2009). Genetic analysis of Nile tilapia (*Oreochromis niloticus*) selection line reared in two input environments. Aquaculture, 294: 37–42.

Kubitza, F. (2000). Tila´pia: tecnologia e planejamento na produc¸a˜o comercial. F. Kubitza, Jundiaı, p 285.

Le Cren, E. D. (1951). The length-weight relationship and seasonal cycle in gonad weight and conditions in the perch *Perca fluviatilis*. J. Animal Ecol., London, 20(2): 201-219.

Little, D. C. and G. Hulata (2000). Strategies for tilapia seed production. In: Beveridge MCM, Mcandrew BJ (eds) Tilapia: biology and exploitation. Kluwer Academic Publisher, Dordrecht.

Little, D. C., D. J. Macintosh and P. Edwards (1993). Improving spawning synchrony in Nile tilapia, *Oreochromis niloticus* (L). Aquaculture and Fisheries Management, 24: 399-405.

Mair, G., C. S. Lakapunrat, W. L. Jere and A. Bart (2004). Comparisons of reproductive parameters among improved strains of Nile Tilapia *Oreochromis niloticus* L. Proceeding of the Sixth International Symposium on Tilapia in Aquaculture, Manila, Philippines (ed. by R. Bolivar, G. Mair & K. Fitzsimmons). Pp142-156.

Macintosh, D. J. and D. C. Little (1995). Nile tilapia *Oreochromis niloticus*. In: Bromage, N.R., Roberts, R.J. (Eds.). Broodstock Management and Egg and Larval Quality, Blackwell Science Publication, University Press, Cambridge, UK, 424 pp.

Mohamed, W. M., S. M. A Shehata, G. O. El-Naggar, A. M. M. Khater and M. K. Mahmoud (2014). Effect of female weight on reproductive performance of Nile tilapia (*Oreochromis niloticus*) 4th Conference of Central Laboratory for Aquaculture Research, 315-332.

Msiska, O. V. and B. A. Costa-Pierce (1997). Factors affecting spawning success of *Oreochromis karongae*. Aquac Res., 28: 87–99.

Ponzoni, R. W., J. W. James, N. H. Nguyen, W. Mekkawy and H. L. Khaw (2013). Strain comparisons in aquaculture species: a manual. Manual: 2013-12. WorldFish, CGIAR Research Program Livestock & Fish. Penang, Malaysia.

Rezk, M. A., R. W. Ponzoni, E. Kamel, G. John, T. Dawood, H. L. Khaw and M. Megahed (2009). Selective breeding for increased body weight in a synthetic breed of Egyptian Nile tilapia, *Oreochromis niloticus*: Response to selection and genetic parameters. Aquaculture, 293: 187–194.

Ricker, W. E. (1975). Computation and interpretation of biological statistics of fish populations. Fish. Res. Board Can. Bull., 191: 1-382

Ridha, M. T. (2004). Observation on the reproductive performance of three mouth-brooding tilapia species in low salinity underground water. Aquaculture Research, 35: 1031-1038.

Ridha, M. T. (2010). Spawning performance and seed production from hybridization between *Oreochromis spilurus* and the GIFT strain of the Nile tilapia *Oreochromis niloticus*. Aquaculture Research, 41: 723-729.

SPSS (2013). IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.

WorldFish Center (2004). GIFT Technology Manual: An Aid to Selective Breeding. WorldFish Center, Penang, Malaysia. 56 pp.

الاداء التناسلى و النمو المبكر لثلاث سلالات من البلطى النيلى فى مصر: عباسه، كفر الشيخ ومنزله

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اشتملت الدراسه على مقارنه عدد من مقاييس الاداء التناسلى واداء النمو المبكر فى ثلاث سلالات من البلطى النيلى منهم سلاله محسنه وراثيا لوزن الحصاد ومعدل البقاء (عباسه) و سلالاتين تجاريتين غير محسنتين (كفر الشيخ ومنزله). خزن ١٠٠ أنثى و٣٠ ذكر من كل سلاله فى خمسه هابات (٣ x ٨ x ١ م). بعد أربعه أسابيع فتره أقلمه وإعداد تم تنفيذ ٥ دورات تفريخ فى كل دورة يتم اختيار ٣٦ انثى و ١٢ ذكر من كل سلاله يتم وضعهم فى ٦ هابات تزاوج (١ x ٢ x ١ م) كل مجموعه مكونه من ذكرين و٦ اناث وذلك لتقدير عدد من المقاييس التناسليه. تم اختيار ١٠٠٠ زريعه من كل سلاله بصورة عشوائيه من انتاج أول دورة تفريخ وتم تخزينهم بكثافه ٢٥٠ زريعة/هابه فى ١٢ هابه (٣ x ٤ x ١ م) أربعه مكررات من كل سلاله وذلك لفتره نمو امتدت ستون يوما. السلاله التجاريه المحليه كفر الشيخ أظهرت تفوقا عن سلاله عباسه فى وزن المبيض ودليل المناسل الى وزن الجسم والخصوبه الكليه و الخصوبه النسبيه (٣١، ٤١، ٤٠ ، ٤١ % على الترتيب). سلاله منزله ايضا كانت أعلى من سلاله عباسه فى دليل وزن المناسل الى وزن الجسم والخصوبه الكليه و الخصوبه النسبيه (٢٠، ٢٢، ٢٥ % على الترتيب). عدد الزريعه لكل انثى و عدد الزريعه / جرام وزن انثى كانا أقل فى عباسه عنهم فى كفرالشيخ (٢٤.١ و ٢٦.٤ % على الترتيب) وعنهم فى منزله (١٦.٣ و ١٦.٠١ % على الترتيب). كل الصفات التناسليه المدروسه كانت أعلى معنويا فى شهر يونيه ويليه شهر مايو من بين الخمسه شهور المدروسه. فيما يخص اداء النمو المبكر وزن الجسم النهائى ومعدل الإعاشه % لسلاله عباسه كانا أعلى معنويا ($P<0.01$) عنهما في كفر الشيخ ومنزله. معدل النمو اليومي وعامل الحالة كانا ايضا أعلى معنويا ($P<0.001$) في عباسة عنهما في كفر الشيخ ومنزلة. الخلاصة أن سلاله عباسة أظهرت أسوء نتائج في مقاييس الاداء التناسلي و كانت الأحسن في اداء النمو المبكر.