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EFFECT OF PHOTOPERIODS MANIPULATION ON GROWTH AND SOME REPRODUCTIVE ACTIVITIES OF NILE TILAPIA (*Oreochromis niloticus*)

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ABSTRACT

The effect of Photoperiod manipulation on growth and some aspects of reproductive performance in Nile tilapia (*Oreochromis niloticus*) was studied at Animal Production Department, Faculty of Agriculture. The experimental work was conducted at Central Laboratory for Aquaculture Research Center, Ministry of Agriculture, Egypt . Ninety females and Ninety males Tilapia fish (50±5g) each was reared in aquaria of 150x50x50 cm and treated with three different photoperiods: 18 L: 6 D, 6 L: 18 D, and natural photoperiod 12 L: 12 D (L, Light; D, Dark). Each treatment consists of 30 males and 30 females which were divided into three replicates. In whole experimental period which lasted for 6 months, other environmental factors were maintained at constant level like, light intensity (500 Lux), water temperature (28°C), pH (9) and dissolved oxygen (6 mg/l). Under these conditions and treatments females and males were weighed and the ovary weight, egg weight, egg number, egg diameter, spawning periodicity and sperm count were recorded. The results showed an increase in male and female weights with increasing time and exposure to photoperiod. Also, ovary weight, egg weight, egg number, egg diameter have the same trend. Long photoperiodic exposure has positive effect on spawning periodicity of Nile Tilapia. The final weights of females and males after six months were significantly higher in L 18:6 D than other light treatments. Egg diameter, final egg number per female, and egg weight were increased significantly with increasing photoperiod. Also, the average final sperm count per male in different light schedules was significant. Long photoperiodic exposure has positive effect on (spawning periodicity) mean time interval until first spawn and mean ISI (inter-spawn-interval) in different light periods were enhanced in longer photoperiod than other treatments .The final average serum estradiol in female and final serum testosterone in males are in favor of longer photoperiods than short or natural photoperiod. It could be concluded that growth and reproduction performance in *O. niloticus* can be improved by exposing Nile Tilapia to 18 hours light: 6 hours dark and water temperature of 28°C and pH 9.

Key words: Photoperiods manipulation , reproductive activits, Nile Tilapia, spawning periodicity.

INTRODUCTION

Aquaculture has been growing steadily in recent times as an excellent source of high-quality protein (Krishen *et al.*, 2009). Researchers focused on Nile tilapia because of its quick reproduction rate, tolerance to hard environments endurance to disease and the possibility to be cultured under diverse farming systems (Yosef, 2009; Soto-Zarazúa *et al.*, 2010).

Female Tilapia have individual patterns of ovarian development so that in breeding populations they tend to spawn asynchronously every 3 to 4 weeks, depending upon environmental conditions (Coward and Bromage, 2000). Female tilapia tends to mature and reproduce early at small size before reaching market size (Longalong *et al.*, 1999; and Lutz *et al.*, 2003). The maturation process involves significant changes in teleosts

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including inhibition of growth mechanism (Gines *et al.*, 2003). Tilapia species tend to sacrifice growth to maintain reproductive capacity (Coward and Bromage, 1999) and have also been reported to exhibit tremendous plasticity in growth and maturation (Turner and Robinson, 2000). In physiological terms, early sexual maturity results in reduced growth and consequently poor feed conversion performances. In economic terms, this phenomenon means higher feed costs and lower profitability for tilapia enterprises. Photoperiod could be used as a powerful environmental tool for broodstock management and increasing somatic growth of Nile tilapia (Campos-Mendoza *et al.*, 2004 ; Sawhney and Gandotra, 2010).

Long photoperiod treatments either improve food-processing efficiency directly or suppress sexual maturation thus, redirecting energy from gonadal development to somatic growth (Gines *et al.*, 2004). Onumah *et al.*, 2010 reported that extended photoperiod increase growth rate without affecting other performance traits (egg qualities and fecundity).

Major environmental factors involved in cueing reproductive activity are temperature and photoperiod (Ballarin and Hatton, 1979; Lowe-McConnell, 1979; Eyeson, 1983`; Emit *et al.*, 1989). Bhujel (2000) has reported that photoperiod and light intensity might play an important role in controlling reproduction. Ridha and Cruz (2000) reported that longer and brighter days (18L: 6D with 2500 lux) produced more fry and improved spawning synchrony in Nile tilapia compared with short day and low light intensity (500 lux), also they reported that the degree of spawning synchrony and percentage of the sac and swim-up fry stages were significantly higher in the 2500 lux/18 hr., treatment than in the other treatments. Under the conditions tested, seed production and spawning synchrony in the Nile tilapia may be improved by subjecting breeders to a light intensity of 2500 lux and a photoperiod of 18 hr., day^{-1}.

The majority of the studies deals with the impact of long-day photoperiod on growth and reproduction in tilapia were carried out on the earlier stages of fish development (fries or fingerlings), and few were focused on late stage. Boeuf and Le Bail (1999) have reported that receptivity of fish to light profoundly changes according to species and development status.

In addition it was reported (Bromage *et al.*, 2001) that using photoperiodic manipulation produce sufficient numbers of eggs and fry at desired times and thereby ensure all year round production of rainbow trout.

The purpose of the present study was to investigate the effects of photoperiod on growth and reproductive performance of *Oreochromis niloticus* at late stages of development. Also ensuring the possibility of obtaining eggs and fries at desired time of the year.

MATERIALS AND METHODS

The study was carried out at Animal Production Department, Faculty of Agriculture and the experimental work was conducted in Central Laboratory Aquaculture Research (CLAR), Abbassa, Abou Hamade District, Sharkia Governorate, Egypt. The experiment lasts for 6 months from March till September 2012.

Experimental Design

A number of 180 Nile tilapia (*Orechromis niloticus*) with average 50±5g body weight (90 males and 90 females) were reared in 9 aquaria of 150×50×50 cm under three different photoperiod treatments, long day (18 L: 6 D), short day (6 L: 18 D), and natural photoperiod (12 L: 12 D) (L, Light; D, Dark). Each treatment consists of 3 aquaria and 30 males and 30 females. 3 aquaria under a natural photoperiod and 6 aquaria were provided with lampe light intensity 500 Lux (controlled by 24 hr., timers), lab (window and door) were covered by black vinyl sheets to provide complete darkness. In whole experimental interval other environmental factors were maintained at constant level like; light intensity (500 Lux). Water temperature was (28°C) controlled by thermostatically-controlled water heaters, dissolved oxygen and pH were maintained at 6 mg and 9, respectively.

Fish were fed twice daily with commercial pelleted feed 35% protein at rate 3% from body weight. Settling tanks were cleaned twice in weak concomitant with a 10–20% water change.

In female: body weight, ovary weight, egg production (number, weight and diameter), spawning periodicity, gonad index, fertilization rate, hatching rate and hormonal profile of testosterone and estradiol were estimated at the beginning of experiment, after 3 and 6 months of treatments.

In male: body weight, sperm count and hormonal profile of testosterone and estradiol at the same former periods were determined.

Experimental Procedures

Growth performance

Growth performance was measured by weighing the fish individually (males and females) at the beginning of experiment and at three and six months using an electronic balance.

Reproductive performance

Spawning periodicity

Spawning activity was recorded for each fish, estimates of spawning periodicity (inter-spawn-interval and mean day's elapsed spawn-1) were determined as:

ISI (inter-spawn-interval) based upon completed reproductive cycles of repeat spawning fish only, *i.e.*, the time elapsed from one spawn to the next.

Egg number

The eggs were placed in a 0.9% saline solution and were counted.

Total egg weight

Mean egg dry weight was determined by placing eggs on filter paper for 2 minutes then weighed on electronic balance.

Single egg weight

Mean single egg weight was determined by dividing total egg weight on egg number.

Egg diameters (mm)

Since eggs are ellipsoid-shaped, both axes (long and short) were measured under a calibrated binocular microscope in order to calculate mean egg diameter [(length + width)/2] according to (Coward *et al.*, 1998).

Fertilization and hatching rate

Fertilized eggs in the buccal cavity for each fish were collected and the percentage of fertilization and hatching rate were estimated according to Gheyas *et al*. (2001) as follows:

Fertilization rate (%)= number of fertilized eggs/ total number of eggs x100 ,then eggs were removed to the spawning funned four days after fertilization the larvae were removed to tanks to be counted to determine the hatching rate.

Hatching rate (%) = (number of hatched eggs/ total number of fertilized eggs) × 100

Gonads index

Gonads were removed from three females of each treatment and Gonado somatic index (GSI) was calculated as gonad weight/total body weight ×100.

Sperm count in males

Milt was collected from males by massaging the ventral part over the gonads and at the same time collecting the sperm with a pipette and total sperm number of each individual was calculated with a Bürker’s cell hemocytometer. Sperm concentration is expressed as the number of spermatozoa per milliliter.

Testosterone and estradiol hormone assay

Blood was collected from males and females and the serum levels of Testosterone and Estradiol concentration were assayed at zero time and after three and six months of treatment. Regarding to estradiol hormone (Pg/ml), the calbiotech-Inc E2 Estradiol kits was based on the principle competitive binding between E2 in the test specimen and E2 Estradiol enzyme conjugated for a constant amount of anti-Estradiol polyclonal antibody. A standard curve was obtained by plotting the concentration of the standard versus the absorbance (Gore-langton *et al.*, 1988).

The testosterone (ng/ml) assay is based on the principle of competitive binding between testosterone in the test specimen and testosterone-HRP conjugate for a constant amount of mouse and anti-testosterone, the color development was stopped with the addition of stop solution, and the absorbance is measured spectrophotometrically at 450 mm (Chen *et al.* 1991).

Statistical Analysis

The obtained data of fish were subjected to one-way ANOVA. Differences between means were tested at the 5% probability level using Duncan test (Duncan, 1955). All the statistical analyses was done using SPSS program version 10 (SPSS, Richmond, USA) as described by Dytham (1999) according to the following statistical model.

Where:

$$Yij = M + Ti + Sj + eij$$

Yij is an observation, M is the overall mean, T is the fixed effect of treatment level (I = 1, 2 and 3), S is fixed effect of time (j = 1,2and3), and eij is the random error.

RESULTS

Growth Performance

The results concerning the effects of different light schedules on growth of both females and males of Nile tilapia are presented in Table 1. It could be noticed that there were no significant differences in fish weight among different treatment groups at the beginning of study. After 6 months of treatment, the differences in final body weight of females and males were statistically significant (P>0.05) being the highest at 18 L: 6 D light regime and the lowest at 6 L: 18 D light regime. At three months of treatment the same trend was noticed. It could be also noted that at each light schedule, males and females weights, naturally increase significantly as the age progresses up to 6 months experimental periods.

Reproductive Performance

The average ovary weight as affected by different light regimes is presented in Table (2). The results show a significant effect for these light treatments on ovary weight, with the highest values after 6 months of (18 L: 6 D) light regime. After 3 months, the same trend was also observed. Within each treatment, the values of studied character also increased significantly as experimental period progresses.

The results in Table 3 show that the initial total egg weight (TEW) and single egg weight (SEW) in different light periods were not affected significantly, whereas the final weight was significantly affected, being the lowest (P<0.05) at 6L: 18D light regime and the highest at 18L: 6D.

The egg diameter of treated females (Table 4) showed significant (P<0.05) differences due to exposure to different light schedule at both 3 and 6 months of treatment. The (18L : 6D) schedule was the highest, while 6L: 18D was the lowest in terms of egg diameter of treated females. Similar trend in egg diameter was found for egg number. The egg number increased significantly under long day treatment.

Sperm count per male (Table 5) was significantly (P<0.05) affected with different treatments of light regime. The 18L : 6D was the most superior, while 6L: 18D light regime resulted in the least sperm count values, this was observed at 3 and 6 months of treatment.

Table 6 reveals that the mean time interval until first spawns (day) was significantly shorter under 18 L: 6 D than other treatments. There were significant differences detected when comparing inter-spawning-interval (ISI) among different photoperiods, the longest ISI was found in the 6 L: 18 D treatment. The 18 L: 6 D photoperiod produced the highest values of Gonado somatic index, fertilization rate, hatching rate and survival rate than the other treatments. The differences were significant among all treatments only for GSI. and between long and short day light for the rest characters (Table 6).

Testosterone hormone in male fish showed that the significantly (P<0.05) highest and lowest levels were noticed after 3 and 6 months of 18 L: 6 D and 6 L: 18 D lighting regimes, respectively. The natural lighting took a moderate situation between the two former regimes, where the testosterone hormone in female fish showed another pattern, hence for unknown reasons it showed the highest level at 6 L: 18 D system, and the lowest was at 18 L: 6 D system.

Estradiol hormone assay in males and females fish (Table 8) showed that in males, the highest values of hormone were noticed after 3 and 6 months of treatment with 6L: 18D regime.

Table1. Average females and males weight (g) of Nile Tilapia (*Oreochromis niloticus*) as affected by different light regimes during experimental periods

	Time (month)	Light regime			F value	P value
		18L:6D	6L:18D	Natural		
Females	Initial female weight	50.96^{az}±3.00	50.00^{az}±0.35	50.16^{az}±0.46		
	After 3 months	82.20^{ay}±0.71	72.46^{by}±2.24	80.63^{ay}±0.84	16.12	0.155
	After 6 months	117.33^{ax}±2.34	88.11^{cx}±7.86	106.66^{bx}±3.50		
	F value		6.62			
	P value		0.235			
Males	Initial male weight	54.70^{az}±0.565	55.9^{az}±2.04	56.60^{az}±0.83		
	After 3 months	83.40^{ay}±1.00	73.43^{cy}±2.06	80.63^{by}±0.83	10.06	0.194
	After 6 months	119.66^{ax}±2.17	92.00^{bx}±2.06	116.33^{ax}±1.58		
	F value		3.39			
	P value		0.316			

Means bearing the same letters within the same row (a-c) or column (x-z) are not significantly (P> 0.05) different.

Table 2. The ovaries weight (g) of female Nile tilapia (*Oreochromis niloticus*) as affected by different light regimes during experimental period

Time (month)	18L:6D	6L:18D	Natural	F value	P value
Initial ovary weight	0.51^{az}±0.03	0.48^{az}±0.03	0.47^{az}±0.04		
After 3 months	1.23^{ay}±0.03	0.88^{cy}±0.11	1.166^{by}±0.02	106.3***	0.003
After 6 months	1.76^{ax}±0.03	1.45^{cx}±0.07	1.67^{bx}±0.02		
F value		4.59			
P value		0.09			

Means bearing the same letters within the same row (a-c) or column (x-z) are not significantly (P> 0.05) different.

Table 3. Average total female egg weight (g) and single egg weight (mg) of Nile tilapia (*Oreochromis niloticus*) as affected by different light regimes at different experimental periods

	Time (month)	Light regime			F value	P value
		18L:6D	6L:18D	Natural		
Total egg weight per female	Initial egg weight per female	0.49^{az}±0.05	0.49^{az}±0.06	0.50^{az}±0.07		
	After 3 months	0.77^{ay}±0.06	0.59^{by}±0.07	0.72^{ay}±0.04	22.748***	0.006
	After 6 months	1.53^{ax}±0.04	0.97^{cx}±0.03	1.34^{bx}±0.04		
	F value		1.769			
	P value		0.282			
Single egg weight	Initial single egg weight	4.67^{az}±0.23	4.83^{ay}±0.16	4.86^{az}±0.1	2.07	0.241
	After 3 months	6.34^{ay}±0.09	5.33^{cy}±0.18	6.00^{by}±0.15		
	After 6 months	6.60^{ax}±0.11	5.96^{bx}±0.15	6.40^{ax}±0.12		
	F value		4.364			
	P value		0.09			

Means bearing the same letters within the same row (a-c) or column (x-z) are not significantly (P> 0.05) different.

Table 4. Average egg diameter (mm) and egg number of female Nile tilapia (*Oreochromis niloticus*) in different light regimes

	Time (month)	Light regime			F value	P value
		18L:6D	6L:18D	Natural		
Egg diameter	Initial egg diameter	1.44^{ay}±0.03	1.405^{az}±0.01	1.42^{az}±0.03		
	After 3 months	1.77^{ay}±0.03	1.57^{cy}±0.02	1.71^{by}±0.02	361**	0.03
	After 6 months	1.89^{ax}±0.02	1.66^{cx}±0.03	1.81^{bx}±0.03		
	F value		841**			
	P value		0.02			
Egg number	Initial egg number	$60.6^{0\ az}$±2.78	62.33^{az}±3.00	64.22^{az}±2.43		
	After 3 months	133.00^{ay}±4.33	90.33^{cy}±2.0	124.00^{by}±2.45	41.02***	0.002
	After 6 months	226.00^{ax}±5.14	168.00^{cx}±4.06	$205^{.00bx}$±6.12		
	F value		1.7			
	P value		0.291			

Means bearing the same letters within the same row (a-c) or column (x-z) are not significantly (P> 0.05) different.

Table 5. Average sperm count per male (sperm/lx10^{12}) of Nile Tilapia (*Oreochromis niloticus*) in different light regimes

Time (month)	Light regime				
	18L:6D	6L:18D	Natural	F value	P value
Initial sperm count	171.50^{az}+5.82	178.50^{az}+7.58	172.5^{0az}+4.34		
After 3 months	249.00^{ay}+3.46	188.50^{cy}+4.33	210.40^{by}+4.03	19.62***	0.008
After 6 months	261.00^{ax}+4.15	197.20^{cx}+15.83	237.70^{bx}+4.42		
F value		6.54*			
P value		0.05			

Means bearing the same letters within the same row (a-c) or column (x-z) are not significantly (P> 0.05) different.

Table 6. Some reproductive parameters of female Nile tilapia (*Oreochromis niloticus*) in different light regimes

Item	18L:6D	6L:18D	Natural
Mean time interval until first spawn (day)	18.9^{0c}±0.5	25.70^{a}±1.3	22.5^{0b}±1.1
Mean ISI (day) (inter-spawn-interval)	21.70^{c}±1.2	31.20^{a}±2.1	26.50^{b}±1.3
GSI (%)	1.87^{a} ±0.2	0.92^{c} ±0.02	1.650^{b}±0.02
Fertilization rate (%)	98.1^{0a} ±2.2	78.2^{0b} ±4.2	99.20^{a}±5.8
Hatching rate (%)	85.40^{a} ±1.7	69.40^{b} ±1.6	80.6^{0a}±3.6
Survival rate (%)	83.40^{a} ±1.4	60.20^{b} ±2.1	80.10^{a}±4.2

Means bearing the same letters (a-c) within the same row are not significant (P> 0.05).

Table 7. Average serum testosterone (ng/ml) of males and females Nile tilapia (*Oreochromis niloticus*) in different light regimes

	Time (month)	Light regime				
		18L:6D	6L:18D	Natural	F value	P value
Testosterone in males	Initial	0.729^{az}±0.011	0.731^{az}±0.014	0.726^{az}±0.023		
	After 3 months	0.945^{ay}±0.007	0.851^{cy}±0.012	0.889^{by}±0.021	15.664	0.157
	After 6 months	1.069^{ax}±0.032	0.885^{cx}±0.011	0.946^{by}±0.018		
	F value		18.527			
	P value		0.145			
Testosterone in female	Initial	0.221^{ax}±0.003	0.220^{ax}±0.006	0.225^{ax}±0.009		
	After 3 months	0.185^{by}±0.003	0.197^{ay}±0.005	0.192^{by}±0.003	7.716	0.219
	After 6 months	0.153^{cz}±0.004	0.189^{ay}±0.006	0.175^{bz}±0.005		
	F value		4.456			
	P value		0.281			

Means bearing the same letters within the same row (a-c) or column (x-z) are not significantly (P> 0.05) different.

Table 8. Average serum estradiol (Pg/ml) in male and females Nile tilapia (*Oreochromis niloticus*) in different light regimes

	Time (month)	Light regime				
		18L:6D	6L:18D	Natural	F value	P value
Estradiol in male	Initial estradiol in male	49.3^{ax}±1.83	50.18^{ax}±1.83	48.26^{ax}±1.82		
	After 3 months	35.43^{cy} ±1.56	45.03^{ay} ±0.75	40.56^{by}±1.59	16.225	0.154
	After 6 months	26.5^{cz} ±1.05	39.11^{az} ±1.37	30.73^{bz}±1.46		
	F value		10.80			
	P value		0.188			
Estradiol in female	Initial estradiol in female	288.86^{az}±3.00	289.24^{az}±6.21	286.76^{az}±5.35		
	After 3 months	343.16^{ay} ±5.17	303.36^{cy} ±4.48	321.73^{by}±3.75	9.103**	0.031
	After 6 months	377.16^{ax} ±4.47	314.28^{cx} ±3.40	339.71^{bx}±3.75		
	F value		3.420			
	P value		0.136			

Means bearing the same letters within the same row (a-c) or column (x-z) are not significantly (P> 0.05) different.

In contrary, estradiol values, in females, were the highest ($P<0.05$) under 18 L: 6 D and the lowest at 6 L: 18 D at 3 and 6 months of light treatment. Under the condition of this work, it could be mentioned that, response of both males and females, in terms of sex steroid hormones, to the above mentioned light system is different.

In other words, it is worth noticing that testosterone and estradiol hormones in males and females, respectively responded positively to long day, while testosterone in females and estradiol in males responded more clearly to short day but not long day.

DISCUSSION

In the present study, a significant increase in females and males weight in longer photoperiod subjected group (18L: 6D) was reported. These results agree with Gines *et al.* (2004), Biswas *et al.* (2008), El-Sayed and Kawanna (2004), Rad *et al.* (2006), Cruz and Brown (2009), Onumah *et al.* (2010), Ali and El-Feky (2013) and Elsbaay (2013). It was found that the increased growth rate of fishes at longer photoperiod is believed to be attributed to improved appetite, increased feed intake, higher feed efficiency, higher digestibility and suppressed sexual maturation. (Gines *et al.* 2004; Biswas *et al.* 2005) Energy metabolism and somatic growth in teleosts are regulated by a complex endocrine system that directly or indirectly involves a variety of hormones. Central in the hormonal control of growth is the GH–IGF-I axis. GH and IGF-I have both metabolic and growth-promoting functions. Additionally, Biswas *et al.* (2008) noted an increase in body protein and lipid with increasing photoperiod, that may be attributed to the protein being deposited in the body to enhance growth.

On the other hand, the growth and metabolic rates of several other species were not significantly affected by photoperiods (Hallaraker *et al.*, 1995). According to the results of Onumah *et al.* (2010), the photoperiod recommended for seed production coincided to obtain bigger growth rate where breeders under longer photoperiod exhibited higher fecundity, an extended photoperiod will increase growth rate without affecting other performance traits (egg qualities and fecundity).

In this experiment it is apparent that photoperiod length exerted a positive effect on tilapia growth. It is also apparent that the same beneficial effect of photoperiod was exerted on different studied aspects of reproduction in tilapia. This means that photoperiod is adequate to maintain both the growth and reproductive capacity of these fish for the duration of the experiment. Although, in some species, the positive effect of long photoperiod is attributed to suppressed sexual maturation of the fish, leading to the greater proportion of energy directed towards somatic rather than gonadal development (Rodriguez *et al.*, 2001), this is not consistent with the present study probably because the conditions under which these studies were carried out are different. Photoperiod exerts its influence on reproduction in fish by affecting the brain–pituitary–gonadal axis (Bromage *et al.*, 2001). In brief, photoperiod manipulation brings about changes in gonadotrophic releasing hormone (GnRH), and pituitary and plasma FSH (GtH I) and LH (GtH II) (Amano *et al.*, 1994; Davies *et al.*, 1995, 1999). Furthermore, Amano *et al.* (2000) reported that melatonin is one of the factors that mediated the photoperiodic signals in the control of gonadal development in Masu salmon (*Oncorhynchus masou*), and these changes in photoperiod are transduced by the melatonin rhythms which transfer this information to the brain–pituitary–gonadal axis. Bromage *et al.* (1995, 2001) reported that melatonin levels are strongly correlated with photoperiod manipulation in salmonids resulting in the advance or delay of spawning time, suggesting that melatonin works as a regulator in reproductive behavior. (Falcon *et al.*, 1996) also mentioned that the pineal organ of fish, through its 24 hr rhythmic release of melatonin, acts as a transducer of photoperiod, influencing different physiological functions such as reproduction and growth.

The results in Tables 2, 3, 4, 5 and 6 showed significant improvement in reproductive performance with exposure to longer photoperiod (18 hours light and 6 hours dark) comparing with other light schedules. Biswas *et al.* (2005) showed an effect of photoperiod manipulation on reproductive parameters of fecundity, gamete quality, offspring viability

and overall reproductive process.

The Present work demonstrated a positive effect of longer day length (18l : 6 D) regimethe spawning periodicity of Nile tilapia females. These results are in agreement with Use of photoperiod manipulation to alter the incidence of sexual maturation and the time of spawning has been reported for a number of species (Duston *et al.,* 2003; Imsland *et al.,* 2003). Mendoza *et al.* (2014) found significantly larger eggs under normal day length (12 L: 12 D). However, (Ridha and Cruz, 2000) found that fish reared under long day length (18 L: 6 D) exhibited higher total fecundity and relative fecundity, with a reduction in inter-spawn-intervals. Results are in consistency with the present work (Table 6) the length of the inter-spawning-interval (ISI) in tilapia can be influenced by many diverse factors: light intensity (Hyder, 1970) and 'robbing' of eggs from mouth-brooding parents (Siraj *et al.*, 1983). Ridha and Cruz (2000) also suggested that the rapid removal of eggs from actively brooding females might have helped to reduce the ISI. Egg robbing is time consuming and labour intensive and may therefore only be a useful contribution to broodstock management at a very intensive commercial scale.

In this study, Tables (7-8) long photoperiod increased significantly ($p>0.05$) testosterone in males and estradiol in females. These results agreed with Fostier *et al.,* (1983). High concentrations of this steroid in the blood plasma of male fishes and low amounts in the blood of females suggest that 11-ketotestosterone is mainly a male-specific hormone in fishes. Winkler and Wade (1998) reported that testosterone continues to increase in fish exposed to the 6 L: 6 D photoperiod possibly indicating a reduction in the aromatase (a membrane-bound enzyme which is responsible for the conversion of testosterone to 17B-estradiol) activity. Mola and Hrachya (2015) revealed that higher testosterone and 11-ketotestosterone levels in males allowed female individuals to be detected for further farming up to the stage IV of gonad development, *i.e.,* caviar production. The contribution of vitellogenin sequestration to oocyte growth is well recognized (Tyler and Sumpter, 1996) as is the role of E2 in stimulating vitellogenesis (Specker *et al.,* 1994). Testosterone levels in fish decreased in plasma due to exposure to xenoestrogens, and high E2 levels, presumably due to a feedback inhibition in steroids synthesis. Ankley (1998), also reported that estrogen agonists can interfere with the feedback inhibition synthesis of E2, leading to increased steroidogenesis and increased E2 levels. Lee *et al.* (1999) suggested that sex hormones play important role in maintenance of germ cells in the gonad. The Present results agree with these findings that circulating sex hormone levels are positively correlated with germ cell health. Hypothalamus-pituitary-gonad axis regulates reproduction in many vertebrates. Gonadotropin-releasing hormone (GnRH) controls the release of pituitary gonadotropins (GTHs) and the GTHs ultimately control production of sex steroids in the gonad.

In conclusion, this study has shown that photoperiodic manipulation appears to be a reliable and powerful tool for tilapia brood stock management. Further research is needed to fully understand how photoperiod imparts such a powerful effect upon tilapia reproduction. Particular areas of concern include the effects of 'biological' and 'reproductive' age, the precise effects of light intensity, the possible interactions of photoperiod and temperature, and how photoperiod/light intensity might influence the reproductive endocrinology of tilapia, and thus affect the dynamics of ovarian development.

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تأثير استخدام الفترات الضوئية على النمو وبعض الأنشطة التناسلية في أسماك البلطي النيلي

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أُجريت دراسة تأثير الفترات الضوئية المختلفة على النمو وبعض الصفات التناسلية لأسماك البلطي النيلي في قسم الإنتاج الحيواني بكلية الزراعة جامعه الزقازيق وتم إجراء التجربة العملية في المعمل المركزي لبحوث الثروة السمكية بالعباسة. تم استخدام ٩٠ أنثى و٩٠ ذكر من اسماك البلطي النيلي بمتوسط وزن٥٠ ±٥ جم في ٩ أحواض زجاجيه ١٥٠×٥٠×٥٠ سم تحت تأثير فترات ضوئية مختلفة (الفترة الأولى) ١٨ ساعة أضاءه و٦ ساعات إظلام (الفترة الثانية) ٦ ساعات ضوء و١٨ ساعة إظلام (الفترة الثالثة) ضوء وإظلام طبيعي١٢ ساعة أضاءه و١٢ ساعة إظلام وكل معامله بها ٣ أحواض وتشمل ٣٠ أنثى و٣٠ ذكر وذلك تحت شده أضاءه ٥٠٠ لوكس ودرجه حرارة ٢٨ مئوي وتركيز الأس الهيدروجيني ٩ وأكسجين ذائب في الماء ٦ ملليجم/لتر واستمرت التجربة ستة أشهر وتحت هذه الظروف تم اخذ وزن كلا من الذكور والإناث، وزن المبيض، وزن البيض، وزن البيضة الواحدة، وعدد البيض وقطر البويضة، وفترات التفريخ ، ونسبه الإخصاب والفقس، وأيضا عدد الحيوانات المنوية ومستويات هرمون التستسترون والاستراديول ولوحظت النتائج الآتية: زيادة فى وزن الإناث والذكور مع زيادة فتره التعرض للإضاءة وأيضا وزن المبيض ووزن البيض وعدد البيض وقطر البيضة الواحدة كان في نفس الاتجاه، زيادة فتره التعرض للإضاءة له تأثير ايجابي على فترات وضع البيض فى اسماك البلطي النيلي. بالنسبة للوزن النهائي للذكور والإناث بعد ستة أشهر من بداية التجربة زاد زيادة معنوية فى المعاملة ١٨ ضوء :٦ إظلام عن باقي المعاملات، تحسن وزن المبيض وعدد البيض النهائي من كل أنثى و قطر البويضة مع زيادة فتره التعرض للضوء وأيضا عدد الحيوانات المنوية ومستوى هرمون الاستراديول في الإناث والتستسترون فى الذكور زاد زيادة معنوية، زيادة فتره الإضاءة كان له تأثير ايجابي على فترات وضع البيض عن الفترات الأخرى، يمكن استنتاج أن الأداء التناسلي في اسماك البلطي النيلي يمكن تحسينه بزيادة فتره التعرض للإضاءة حتى ١٨ ساعة أضاءه و٦ ساعات إظلام تحت درجه حرارة ٢٨ درجه مئوية وتركيز الاس الهيدروجينى ٩.

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