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EFFECT OF USING DIFFERENT WATER SOURCES ON THE GROWTH PERFORMANCE OF MONO SEXED NILE TILAPIA *(OREOCHROMIS NILOTICUS)* REARED IN EARTHEN PONDS

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ABSTRACT

This study was carried out to investigate the effect of water which used in aquaculture on growth performance of mono sexed Nile tilapia *(Oreochromis niloticus)* reared in earthen ponds. Experimental period was from 15 April to 15 November 2009 at Central Laboratory of Aquaculture Research Central - Abbassa – AbouHamad – Sharkia Governorate - Egypt The study was conducted in three treatments each in triplicate. 1- Fresh water 2- fertilized fresh water 3- Agricultural drainage water. Area of each ponds 5 feedan area was stocked with 40000 fish/pond and fish were fed on 25% CP diet at a daily rate of 3% of the total fish biomass.

Obtained results are summarized in the following:

1- Water temperature, Dissolved Oxygen, Secchi Disk, pH, PO4, NH3,total Alkalinity and total hardens were within the acceptable levels required for growth of Nile tilapia.

2- Plankton abundant (Phytoplankton and Zooplankton) count was higher in agriculture drainage water followed by fertilized fresh water.

3- The highest final body weight, weight gain, daily gain and specific growth rate were significantly higher in the agriculture drainage water type.

Based on obtained results in this study it could be concluded that Nile tilapia *(Oreochromis niloticus)* can be cultured in earthen ponds and growth parameters of fish improved in agricultural drainage water at the same of experimental conditions.

Key words: Water sources, Nile tilapia, Growth performance, Earthen Pond

INTRODUCTION

Aquaculture nowadays is an important source of animal protein that could meets the world's increasing demand., it contributes about 63% of the total fish production in Egypt (GAFRD 2008) Fish farming are being initiated in many parts of the world, especially in the developing countries thus fish may compensate for the present deficiency of other expensive animal protin sources (Hamza, 1989).Water is a major factor controlling fish production, and it is dramatically influenced by pond's management practices such as stoking density, fertilization regime, water source, and feed supplementation.

Water resources are the most limiting factor to be considered in aquaculture development. The ministry of Public Work and Water Resources began in 1977 implementing water reuse program. Water policy has been set targeting more control on water use in crop production which in turn will lead to reduce the quantity of drainage water available for aquaculture especially the use of water for crop production has priority over aquaculture (El-Gamal 1997).

The culture of tilapia in ponds has along history which dated back to ancient Egypt, Nile tilapia (*Oreochromis niloticus)* is a major fish species reared in aquaculture because it shows rapid growth rates, high tolerance to low water quality, efficient feed conversion, ease of spawning, resistance to disease and good consumer acceptance.

The objective of present study was to determine the effect of water sources which used in aquaculture on growth performance , fish production and economical efficiency of mono sexed Nile tilapia *(Oreochromis niloticus)* cultured in earthen ponds.

MATERIAL AND METHODS

This work was conducted in the region of Abbassa – AbouHamad – AL-Sharkia Governorate - Egypt to investigate the effect of water source on growth performance of *Oreochromis niloticus* under Egyptian conditions. *Oreochromis niloticus* fingerlings used in this experiment were of an average initial weight of 2.3 g. The study lasted 7 months from 15 April to 15 November 2009

Nine earthen ponds of five feedan area each , were used in the present study. All experimental earthen ponds used in this study were stocked by 40000 of Nile tilapia fingerlings/pond. Fish in this experiment were fed on a pelleted diet allover the experimental period (25% CP), the fish diet was offered the ration at a rate of 3% of tilapia biomass per pond.

Three treatments (Three replicates /each) were designed as follow:

1- Treatment1 (Freshwater)FW

In this treatment the experimental ponds were supplied with freshwater from Ismailia canal.

2- Treatment2 (Freshwater and fertilization)FFW

Poultry manure was added at a rate of (25 kg poultry manure / feedan/ biweekly) for the whole experimental period.

3- Treatment3 (agricultural drainage water)ADW

In this treatment the experimental ponds were supplied with agricultural drainage water.

The experimental ponds before being stocked with fish were drained completely and bottoms were exposed to sun radiation for one week thereafterponds were filled with water before they were stocked with the experimental fish.

Physico-chemical parameters were monitored monthly. Temperature and dissolved oxygen were measured by Oxygen-Thermometer apparatus YSI model 58 (Yellow Spring Instrument Co., Yellow Springs, Ohio, USA).

Transparency of water was measured directly by using Secchi disk. Hydrogen ion concentration (pH) was measured using a digital pH meter, Total ammonia concentration was determined using a HACH water analysis while the concentration of total phosphorus was determined according to standard methods of APHA (1985).

Phytoplankton and zooplankton counts were determined in pond water monthly according to methods of APHA (1985).

The initial body weight was recorded at the beginning of the experiment.

According to the data of body weight, at the end of the experimental period**,** fish were harvested, counted and weighed. The growth parameters were calculated as follows**:**

Average daily gain (ADG)= $(Wt_2 - wt_1)/t$

Where:

wt_1 = first fish weight in grams.

wt_2 = following fish weight in grams.

t= period in day.

Specific growth rate (SGR) $= (Ln\ wt_2 - Ln\ wt_1) \times 100/t.$

Where:

wt_1 = first fish weight in grams.

wt_2 = following fish weight in grams.

t= period in day.

Ln = $(\log l0x)^{3.303}$

The food conversion ratio was calculated according to following equation:

$$FCR = \frac{Total\ feed\ consumption\ (g)}{Final\ body\ weight\ (g) - initial\ body\ weight\ (g)}$$

Statistical analysis:

Statistical analysis was performed using the analysis of variance (ANOVA) and Duncan's Multiple Range Test to determine differences between treatment means at significance level of $p < 0.05$ and also differences between monthly means at significance level of $p < 0.05$. Standard errors were also estimated according to Dytham (1999).

RESULTS AND DISCUSSION

Obtained data summarized in table (1). The water temperatures were not affected by water types, because water temperature is related to air temperature an these results are completely in agreement with the finding of (Boyd 1990).

Dissolved Oxygen (DO) value was the highest in the drainage water 6.67 and lowest concentration was in fresh water, increasing in DO concentration may due to the concentration of natural food (Phytoplankton) which considered the main generator of Oxygen. These results are agreement with those reported by Khattaby (2007), moreover Smith and Piedrahita (1988) reported that the maintaining of algal biomass between 150 and 350 mg/m^3 chlorophyll, (optimizing phytoplankton management) could provide an extra 8 to 10 g/m^3 of Oxygen per day.

Secchi Disk (SD) reading was the lowest in drainage water and highest in fresh water ponds indicating the low abundance of plankton in these ponds compared to the fertilized fresh water ponds and drainage water ponds and these results are in agreement with results of Shaker and Abdel-Aal (2006).

The lowest Hydrogen Ion Concentration (pH) values were recorded in pond water of the treatments was 8.17 in fresh water while highest value was 8.87 in fertilized fresh water and this variation could be explained by photosynthetic activity, these values were still within the save limits of hydrogen ion concentration which is typically in accordance with the report of Tucker and Boyd (1985) who said that there are a relationship between photosynthesis respiration and pond water pH.

The highest concentration of phosphorus showed in ponds which irrigated by drainage water in all months. This result is in accordance with Ellawa (2008) who reported that the highest concentration appeared in ponds which used drainage water.

In the same table NH_3 showed significant differences among all treatments in Jon, September and October the highest values were in ponds which used drainage water which may due to concentration of organic mater in ponds but these values are in save limits according to El-Dahhar *et al* (2006)

Results of the abundance of Green algae presented in table (2). The results showed a wide variation between the three water sources where the highest count was (47756.92 organism/ml) obtained under ADW treatment and Lowest counts (5837.71 organism/ml) which recorded using FW.

The maximum counts of Blue green algae (6197.479 organism/ml) were observed using ADW while the minimum count (1327.031 organism/ml) was noticed under the treatment which used FW.

Concerning to counts of Diatoms, the highest count (6138.393 organism/ml) was observed using ADW and the lowest counts (484.944 was observed using FW.

Simi on results were observed with the maximum counts of Euglena (2574.842 organism/ml) were observed using ADW while the minimum counts (484.944organism/ml) was noticed under the treatment which used FW.

Generally, Total phytoplankton counts showed their highest values (15666.91 organism/ml) at the treatments used ADW and the lowest counts (2033.657 organism/ml) was recorded at FW. These results may du to effects of nutrients which present in Agricultural drainage water especially phosphorus and nitrogen. In this regard, Hietala *etal.* (2004) found that nutrient enrichment clearly increased the biomass of phytoplankton. They also reported that the highly significant effects of nutrients on the total biomass of phytoplankton probably masked the effects of fish.

Result of the counts of zooplankton presented in table (3) show that the maximum counts of Rotifer (590) were noticed in ADW while the minimum counts (100) were recorded in FW. Same results were obtained for copepods when maximum counts of copepods (540) were noticed in ADW while the minimum counts (245) were recorded in FFW. On the other hand Cladocera were found only in FFW. The changes in zooplankton

count and structure are strongly affected by seasons and years or environmental conditions, phytoplankton occurrence and/or the impact of cultured fish,
result of these study are in accordance with finding of Khattaby (2007)

Averages of body weight of Nile Tilapia as affected with water types during the experimental periods are presented in table (4). At the start of the experimental period averages of initial weight ranged between 2.20 and 2.36 g. and differences between the experimental groups was insignificant indicating that distribution of experimental fish was completely random. Seven months after the experimental start results revealed that averages of find body weight of Nile Tilapia increased significantly ($P < 0.05$) in ponds receiving at the agriculture drainage water . At the end of experimental period, averages of final weights were 223.06, 272.79 and 330.80 for the groups FW , FFW and ADW , respectively (table 4).

The analysis of variance for final body weight indicat that final body weights of Nile Tilapia increased significantly ($p < 0.05$) agriculture drainage water . The results indicated that Nile tilapia reared in earthen ponds with agricultural drainage water resulted in higher ($p < 0.05$) final weights compared to other treatments

As described in Table (4) the body weight gain of Nile tilapia was 220.73, 270.43 and 328.60 g. for FW , FFW and ADW, respectively.with significant differences among treatments for the favor of ADW.

Daily gain (g) was between 1.05 and 1.56 g/day. Specific growth rate (SGR) recorded 2.17, 2.26 and 2.39 for FW, FFW and ADW, respectively. Where fish in ADW recoded the highest ($p<0.05$)records followed in a significant decreasing order by FFW and FW respectively.

There results may be due to the concentration of natural food (phytoplankton and zooplankton). These results are in agreement with those of McDonald (1985) who found that tilapia fish (*Oreochromis aureus*) fed blue green algae (Anabaena spp.) gained more weight than the control. Tefei *et al*. (2000) demonstrated that *O. niloticus* was found to be essentially phytoplanktivorous in Lake Chamo, the blue green algae contributed over 60% of the total food ingested, of these, more than 50% was due to Anabaena. From these data, it can be concluded that fish do not need to be fed immediately after stocking but can be supported by the natural food in the pond ecosystem (Abdelghany *et al*., 2002 and

Kamal and Agouz 2006). Nutrient enrichment can enhance primary productivity in aquatic ecosystem (Geiger, 1983). The increase of plankton abundance can significantly increase fish production in ponds (Geiger and Parker, 1985).

From data of table (4) Food conversion ratio (FCR) was 1.85, 1.68 and 1.43 for FW, FFW, ADW respectively. The best food conversion ratio was in treatment which used Agriculture draining water (ADW). This results due to effects of nutrients and primary production from plankton which present in Agriculture drainage water. This results are in agreement with khattaby (2007)

The lowest survival rate was showed in treatments which used fertilized water (98.53). this result of decreasing the survival rate may be due to the water quality changes which is in accordance with finding of Muendo *etal* (2006) who reported that in manure and dite-driven tilapia culture environments, both autotrephic and heterotrophic pathways are important processes that result in natural food availability for fish. But Oxygen depletion might be accurse during night time which lead to the mortality as a result of asphyxia and stress.

Table (5) shows the economical evaluation including the costs and results for treatments applied in ton/ feedan and income in (L.E) for 7 month. Total costs were 13150.91, 14470.28 and 14526.16 L.E/ feedan for T_1 , T_2 and T_3 , respectively. These results revealed that the total cost of T_3 was the highest than the other groups. On the other hand the total cost of T_1 was the lowest. Net returns in L.E per feedan were 2400.338, 3453.22 and 4918.84 for T_1 , T_2 and T_3 , respectively. Percentage of net return to total cost for treatments cited above were 18.25, 23.86 and 33.86.99% for T_1 , T_2 and T_3 , respectively, indicating that the highest net returns were obtained with the group T_3 followed by T_2 and T_1. These results indicate that the use agricultural draining water in fish (tilapia) culture increased the total income from feedan

Recommendation:

Based on the obtained results, the best culture of tilapia under the same experimental condition could be of economical impacts using agriculture draining water

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Table 1: monthly means of physico-chemical parameters for water quality of earthen ponds cultured with Nile tilapia as affected by water sources.

Item	treatment	Months						
		may	Jon	July	august	sep	Oct	Ave.
Temp	T1	24±0.3[a]	26± 0.41 [a]	28± 0.32 [a]	29.5±0.60 [a]	27.5±0.33 [a]	24.5±0.43 [a]	26.58
	T2	24±0.5[a]	26±0.57 [a]	28± 0.21 [a]	29±0.72 [a]	26± 0.52 [a]	25± 0.56 [a]	26.33
	T3	26±0.1[a]	27± 0.35 [a]	29± 0.41 [a]	29±0.54 [a]	26± 0.67 [a]	24± 0.78 [a]	26.83
DO	T1	7.5±0.05 [b]	7± 0.11 [b]	4± 0.76 [a]	5.3±0.51 [a]	5.2± 0.32 [a]	4.25±0.35 [b]	5.54
	T2	8 ±0.06 [a]	8± 0.05 [a]	5± 0.57 [a]	5.5± 0.57 [a]	6.2± 0.47 [a]	4.6± 0.26 [b]	6.21
	T3	8 ±0.05[a]	8± 0.06 [a]	4± 0.61 [a]	6± 0.63 [a]	6.3± 0.50 [a]	7.7± 0.51 [a]	6.67
SD	T1	16 ± 0.5 [a]	17.5±0.28 [a]	14± 0.22 [a]	14.5±0.59 [a]	13.5± 0.41 [a]	13± 0.25 [a]	14.75
	T2	15 ±0.7 [a]	15± 0.62 [b]	12±0.35 [a]	15± 0.74 [a]	12± 0.18 [a]	11± 0.37 [a]	13.33
	T3	12 ±0.11 [b]	12± 0.75 [c]	14± 0.41 [a]	13± 0.43 [a]	11± 0.32 [a]	14± 0.13 [a]	12.67
pH	T1	8.76±0.04 [a]	8.25±0.39 [b]	8.42±0.03 [a]	8.44±0.05 [a]	8.17±0.17 [b]	8.45±0.09 [a]	8.42
	T2	8.87±0.03 [a]	8.87±0.32 [a]	8.52±0.05 [a]	8.41±0.06[a]	8.5± 0.23 [a]	8.6± 0.05 [a]	8.63
	T3	8.37±0.05 [b]	8.37±0.36 [b]	8.65±0.07 [a]	8.55±0.04 [a]	8.73±0.19 [a]	8.81±0.07 [a]	8.58
PO_4	T1	0.41±0.08 [b]	0.16±0.01 [b]	0.03±0.001[b]	0.02±0.002[b]	0.01±0.001[b]	0.01±0.001[a]	0.11
	T2	0.19±0.07 [c]	0.11±0.02[b]	0.04±0.001[b]	0.02±0.001[b]	0.02±0.002[b]	0.01±0.003[a]	0.065
	T3	0.53±0.01 [a]	0.21±0.05[a]	0.07± 0.003[a]	0.05± 0.002 a	0.04±0.003[a]	0.01±0.002[a]	0.91
NH_3	T1	0.07±0.008 [a]	0.02±0.003 [c]	0.11±0.005 [a]	0.08±0.002 a	0.03±0.003 [b]	0.04±0.002 [b]	0.06
	T2	0.07±0.005 [a]	0.11±0.005 a	0.17±0.007 a	0.06±0.001ab	0.05±0.007 b	0.06±0.003 b	0.09
	T3	0.05±0.006 a	0.05±0.004 b	0.21±0.003 a	0.1±0.004 a	0.15±0.008 a	0.09±0.001a	0.11

*T_1; T_2 and T_3 means water source Fresh water; fertilized fresh water and Agriculture draining water.
* a,b,c means within each month for each water parameter having the same superscript do not differ significantl

Table (2) monthly means count of Phytoplankton (organism/ml) in water of earthen ponds cultured with Nile tilapia under different water sources

	Fresh water					**Fertilized water**					**Agric. Drainang Water**				
Item	**Green**	**Blue**	**Diatom**	**Eugl**	**Av.**	**Green**	**Blue**	**Diatom**	**Eugl**	**Av.**	**Green**	**Blue**	**Diatom**	**Eugl**	**Av.**
may	5803.57	446.43	630.25	288.87	1792.28	8403.36	1890.76	4359.24	630.25	3820.90	10110.29	1470.59	7536.77	5.252	4780.73
Jon	4109.77	787.82	433.10	210.08	1385.24	7956.93	1234.24	2494.75	498.95	3046.22	20811.45	1575.63	6026.79	475.32	7222.10
July	2415.97	1129.20	236.34	131.30	978.20	7510.50	577.73	630.25	367.65	2271.53	31512.61	1680.67	4516.81	945.38	9663.87
Aug	7457.98	2113.97	538.34	617.12	2681.85	8849.79	3807.77	945.38	603.99	3551.73	56565.13	10399.16	5094.54	2888.66	18736.87
Sep	12500	3098.73	840.34	1102.94	4385.5	10189.08	7037.82	1260.50	840.34	4831.93	81617.65	19117.65	5672.27	4831.93	27809.87
Oct	2738.97	386.03	231.09	559.39	978.86	7773.11	1890.76	1050.42	2521.00	3308.82	85924.37	2941.18	7983.19	6302.52	25787.82
Ave.	5837.71	1327.03	484.94	484.94	2033.66	8447.13	2739.85	1790.09	910.36	3471.86	47756.92	6197.48	6138.39	2574.84	15666.91

*Green, Blue, Diatom and Eugl means Spices of Phytoplankton Green algae, Blue Green algae, Diatom and Euglena respectively

Table 3: monthly means count of Zooplankton (organism/l) in water of earthen ponds cultured with Nile tilapia under different water sources

Month	Fresh water (FW)			Fertilized water (FFW)			Agric Draining Water (ADW)		
	Rot	Cop	Clad	Rot	Cop	Clad	Rot	Cop	Clad
may	0	100	0	50	60	10	330	130	0
Jon	0	100	0	50	65	10	175	120	0
July	0	0	0	0	70	0	20	110	0
Aug.	50	50	0	0	40	0	25	110	0
Sep	50	50	0	0	10	0	30	0	0
Oct	0	0	0	10	0	0	10	70	0
Total	100	300	0	110	245	20	590	540	0

*Rot , Cop, Clad and Ost, means Spices of Zooplankton Rotifer, Copepods , Cladocera and Ostracods respectively

Table 4: Effect of water sources on growth parameters , food conversion ratio and survival of Nile tilapia reared on earthen ponds.

Treatment	Initial Wt (g/fish)	Final Wt (g/fish)	Weight gain g/fish	Daily gain	SGR	FCR	Survival
T1	2.23 ± 0.03 ^{a}	223.06 ± 6.7 ^{c}	220.73 ± 6.7 ^{c}	1.05109 ± 0.03 ^{c}	2.1711623 ± 0.01 ^{b}	1.85 ± 0.03 ^{a}	99.98
T2	2.36 ± 0.17 ^{a}	272.79 ± 19.5 ^{b}	270.43 ± 19.6 ^{b}	1.287762 ± 0.09 ^{b}	2.2607367 ± 0.05 ^{ab}	1.68 ± 0.08 ^{b}	98.53
T3	2.20 ± 0.05 ^{a}	330.80 ± 11.6 ^{a}	328.60 ± 11.7 ^{a}	1.564762 ± 0.05 ^{a}	2.3868967 ± 0.04 ^{a}	1.43 ± 0.02 ^{c}	99.16

*T_1; T_2 and T_3 means water source Fresh water; fertilized fresh water and Agriculture draining water.

Table 5 : the effect of the water types on economical efficiency (Egyptian pounds L.E/Feddan)

Item	**T1**	**T2**	**T3**
- stocking rate	8000	8000	8000
Production Ton/feedan	1.785	2.18	2.6425
- **Operating costs**			
Costs of fish	520	520	520
Costs of feed	9130.912	10150.28	10506.16
Costs of fertilization		300	
Labor	500	500	500
Others	3000	3000	3000
Total costs	13150.91	14470.28	14526.16
- % of the smallest value of total cost	100%	110.03%	110.46%
- **Returns**			
Total returns	15551.25	17923.5	19445
Net returns	2400.338	3453.22	4918.84
% of the smallest value	100%	347.38%	494.81%
%net return to total cost	18.25	23.86	33.86

* the economical evaluation of results was carried out according to market prices in 2009 in L.E.

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أثر استخدام أنواع مختلفة من المياه على الأداء الانتاجى لأسماك البلطى النيلى وحيد الجنس المرباه فى أحواض ترابية

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٢- قسم الانتاج الحيوانى – كلية الزراعة – جامعة بنها

الملخص العربى

تمت هذه التجربة فى الفترة من ١٥ أبريل الى ١٥ نوفمبر ٢٠٠٩ لمعرفة أثر أنواع المياه المستخدمة فى الاستزراع السمكى على الأداء الانتاجى لأسماك البلطى النيلى وحيد الجنس المستزرعة فى أحواض ترابية ، أستخدمت لذلك ثلاث مجموعات من الأحواض الترابية (كل مجموعة ثلاثة مكررات) تروى بثلاث أنواع من المياه

١- مياه عذبة ٢- مياه عذبة مسمدة باستخدام سبلة دواجن ٣- مياه صرف زراعى ، مساحة الحوض خمسة فدان تم تسكينها بعدد ٤٠٠٠٠ سمكة/للحوض تمت تغذية الأسماك بعلف ٢٥% بروتين بمعدل ٣% من الكتلة الحية من وزن الأسماك.

وكانت أهم النتائج المتحصل عليها كالتالى:

١- درجات الحرارة ونسبة الأكسجين الذائب ودرجة الأس الهيدروجينى وشفافية المياه والأمونيا والفوسفور الذائب والقلوية الكلية والعسر الكلى كانت فى الحدود المسموح بها لنمو أسماك البلطى.

٢- أظهرت قياسات الهائمات فى المياه (الهائمات النبايتة والهائمات الحيوانية) زيادة كثافتها فى المجموعة الثالثة (مياه الصرف الزراعى) يليها المياه العذبة المسمدة.

٣- أعلى وزن نهائى ومعدل زيادة كلى ومعدل نمو يومى ومعدل نمو نوعى كان لصالح المجموعة الثالثة (مياه الصرف الزراعى).

بناءاً على النتائج المتحصل عليها توصى الدراسة باستزراع أسماك البلطى النيلى وحيد الجنس فى الأحواض الترابية مع تحسن الانتاج باستخدام مياه الصرف الزراعى تحت نفس ظروف التجربة.