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Effect of fertilization sources with artificial feeding on growth performance, water quality and returns of monosex Nile tilapia (*Oreochromis niloticus*) reared in earthen ponds.

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ABSTRACT

The present study was performed in earthen ponds with a total area of 1.25 feddan each and water column of 1.25 meter. The objectives of this study were to evaluate the effect of source of fertilizers (organic and inorganic) on growth performance, feed and nitrogen utilization, whole body composition, water quality, plankton abundance, costs and net returns of Nile tilapia monosex reared in earthen ponds. The first pond (T1) received chicken manure at a rate of 87.5 kg weekly with artificial feeding (25% protein), the second pond (T1) received artificial feed as in T1 plus chemical fertilization (5 kg/pond urea 46.5 N + triple super phosphate 10 kg/pond weekly). The third treatment (T3) received only artificial feed without any fertilization. The artificial feed was offered at a rate of 3% of pond biomass in two portions at 9.00 am and 3.00 pm daily. The experimental ponds were stocked with 15000 monosex Nile tilapia (*Oreochromis niloticus*) with initial weight ranging between 19.73 and 20.83g and length between 5.5 to 6.0 cm. the experiment lasted 14 weeks after start from August to December 2012. Results obtained are summarized in the following:

1) Water quality parameters tested (water temperature ^{0}C; dissolved oxygen (mg/l); pH value; total ammonia (mg/l); nitrate mg/l; nitrite mg/l and salinity g/l were within the accepTable levels for optimum growth of Nile tilapia.
2) Final weight and length, weight gain, length gain, daily weight gain, specific growth rate and relative growth rate of T1(feed + organic fertilizers) recorded significantly ($p<0.05$) the highest values followed in a significant decreasing order by T2 (feed + inorganic fertilizers) and T3 (feed only), respectively.
3) The best FCR was recorded by T1 followed by T3 and T2, respectively.
4) The applied treatments revealed significant ($p<0.05$) effects on the whole body chemical composition.
5) Average of nitrogen utilization (nitrogen gained in fish bodies/ total nitrogen input × 100) were 35.72; 31.74 and 39.83% for T1; T2 and T3, respectively.
6) The T1 recorded the highest fish production followed in a decreasing order by T2 and T3, respectively.
7) T1 recorded the highest net returns (15613.24 LE) followed in a decreasing order by T2 (8560.07) and T3 (8094.34 LE).

Keywords: Organic and inorganic fertilizers, Artificial feed, Nitrogen utilization, Net returns.

INTRODUCTION

Nile tilapia is one of the most important cultured fish species in fresh water of moderate climates. Tilapia due to its advantages as rapid growth, tolerant to the unfavorable water quality conditions, resistances to diseases and preference of the consumer to this fish become as a most cultured fish species in Egypt. Also, tilapias

production represents approximately 6% of the total farmed fish production (FAO, 2004). In (2011) the total amounts of tilapia produced through different aquaculture activities in Egypt amounted 610617 tons which represent about 61.88% of the total cultured fish species GAFRD (2011). A number of investigations have been done on feed and fertilizer combinations, which may be very effective, where fertilization rates can be reduced due to enrichment, gained from excreta and exhibited rapid growth rate of tilapia, since larger size could be attained in shorter time than fertilizer alone (Milstein *et al*., 1991; Mostafa, 2005) and also the production cost may be reduced (Eroldogan *et al*., 2006; Abdel-Hakim *et al.*, 2009). Among fish culture methods, aquaculture in earthen ponds is the most common practice. The advantage of pond culture is that fish are able to utilize natural foods and the natural can be enhanced by using organic and inorganic fertilizers. Level of nutritional inputs varied from use of fertilizers to use of high quality extruded feed according to production system practiced in the farm. Fish feeds represent the major part of fish production, as it represents about 60-70% of fish farm operation cost. Fish feed prices have increased significantly during the last few years which reduced the profit margin of fish farming and caused losses in some farms. As a direct result of that farming net profits declined and most of the business has changed their production plan depending more on fertilizers. Fertilizers are applied for fertilization of fish ponds to increase plant nutrients contraction and to stimulate natural fish growth and ultimately increase fish production. Availability of natural food in pond water reduces fish require for artificial feeds, leading to reduce production costs and improve farm income. Chicken manure has been used extensively as organic fertilizers in fish farms for increasing natural food web and consequently reducing production costs. Chemical fertilizers are highly soluble and release nutrients that can cause eutrophication of natural water. Organic and inorganic fertilization can produce high plankton abundance to be capable of supporting fish growth (Jha *et al*., 2008). Fertilizers, fresh feed or both are manipulated in fish ponds to increase production (Lane, 2000). Organic fertilizers have been widely used in tilapia, common carp and mullets ponds, especially in Asia (Edwards *et al*., 1994; Shevgoor *et al*., 1994), Central America (Green *et al.*, 1990) and Africa (Hussein 1995). Recent studies have shown that the combined use of organic and inorganic fertilizers is effective in productivity improvement in earthen ponds (Afzal *et al*., 2007; Jha *et al*., 2008 and Abdel-Hakim *et al*. 2013). Moreover, the combined use of inorganic and organic fertilizers is effective in maintaining phytoplankton and zooplankton population in rearing ponds (Afzal *et al*., 2007).
The present study aimed to evaluate the effect of source of fertilizers (organic and inorganic) on growth performance, feed and nitrogen utilization, whole body composition, water quality, plankton abundance and costs and net returns of Nile tilapia monosex reared in earthen ponds.

MATERIALS AND METHODS

The present study was performed in three earthen ponds with dimensions (50×105×1.25m) as width, length and depth respectively, with a surface area of 5250m^2 each (1.25 feddan). The experimental ponds located in Kafr El-Sheikh Governorate, El-Ryyad area belonging to a private fish farm. The water supply of the farm was drainage water from Elgarbia drainage canal. The water exchange rate was 10% of the total pond area daily. These experimental treatments were carried out the first treatment (T1) included fertilization the pond with chicken manure at a rate of 87.5kg/pond weekly plus artificial commercial diet (25% protein) fed at rate of 3% of the pond fish biomass twice a day six days a week. The second treatment (T2) was artificial feeds as in T1 plus chemical fertilization (inorganic) with urea 5kg /pond (46.5/N) and triple super phosphate 10 kg/pond/weekly (20% P.). The third treatment (T3) received artificial feed only as is T1 and T2. The chemical compositions of the organic and inorganic fertilizers are presented in Table (1).

Table 1: Approximate chemical composition (%), of inorganic fertilizers (urea and triple-phosphate) and organic fertilizer (poultry manure) on dry matter basis.

Treatment	Organic fertilizer	Inorganic fertilizer
Moisture(%)	15.60	---
Dry matter(DM %)	84.40	---
Crude protein (CP%)	23.62	---
Ether extract (EE %)	3.20	---
Crude fiber (CF %)	17.0	---
Ash (%)	30.0	---
Nitrogen free extract (NFE %)	26.18	---
Nitrogen (%)	2.18	46.5
Phosphorus (%)	3.00	20

The proximate chemical composition of the artificial diet is illustrated in Table (2). The experimental ponds were stocked each with 15000 of monosex Nile tilapia (*Oreochromis niloticus*) with initial weight ranging between 19.73 to 20.83g; and initial length ranging between 5.5 to 6 cm. The experiment lasted 14 weeks after start. The experiment was carried out during the period from August to December 2012. Every two weeks fish sample of 15 fish from each experimental pond were taken randomly, weight to the nearest 0.1g and fish body length to the nearest 0.1cm were recorded and the amounts of artificial feed were readjusted for the next week.

Table 2: Composition and proximate chemical analysis of the experimental ration.

Item	Ration%
Fish meal	18.56
Soybean meal	13.84
Fish oil	5.00
yellow maize	39.6
Cottonseed meal	17.00
Minerals mix.[1]	4.00
Vitamins Mix.[2]	2.00
Total	100
Proximate analysis (% of dry weight)	
Moisture	18.73
Dry matter	90.41
Crude protein	25.03
Ether extract	6.37
Ash	10.50
Crude fiber	20.53
Nitrogen free extract	37.57
Nitrogen %	1.68
Gross energy (Kcal/kg)[3]	3547

1- Mineral premix (as g/kg premix): $CaHPO_4.2H_2O$ 727.7775; $MgSO_4$. H_2O 127.5 ; Kcal50.0 ; Na Cl 60; Fe $SO_4.7H_2O$ 25; $ZnSO_4$. $7H_2O$ 505 ; $MnSO_4.4H_2O$ 2.53; Cu $SO_4.5$ 0785 ; $CoSO_4.7H_2O$ 0.4775; Ca Lo_3. $6H_2O$ .295; Cr CL_3. $6H_2O$0.1275.

2- Vitamins mixture contained (as g/kg premix): Thiamine 2.5; Riboflavin2.5 ; pyridoxine 2.0; Inositol 100.0; Biotin 0.3; Pantothenic acid 100.0; folic acid 0.75; Para-aminobenzioic 2.5; Choline 200.0; Nicotinic acid 10. Cyanocobalmine 0.005; Tocopherol acetate 20.1; Ascorbic acid 50.0; Menadione 2.0; Retinol palmitate 100.000 IU; Cholecalciferol 500.000 IU.

3- GE (gross energy) calculated using the values 4.1 , 5.6 and 9.44 Kcal GE/g DM of carbohydrate , protein and fat, respectively according to NRC (1993).

The fish samples were returned back to the corresponding experimental ponds after measuring the body weight and length. The fertilizers tested were provided once a week by brood casting at pond water surface. Also, the artificial diet was applied by brood casting the diet over pond water surface in the same place. The diet was fed at 3% rate of pond fish biomass twice daily at 10.00 am and 2.00 pm in two equal portions during the whole experimental period concerning pond water measurement, the inlet pipes were adjusted to allow fresh water to flow into ponds two times per week to compensate water losses through evaporation and seepage to maintain a fixed water level in ponds throughout the whole experimental period.

Growth parameter tested:

Random samples of fish (15 fish /treatment) were weighed every week during the experimental period. Individual body weight 0.1g and body length 0.1cm were recorded for each sample. Growth performance and feed utilization parameters were calculated as follows:

Weight gain (WG) = final mean weight – initial mean weight (g).

Length gain (LG) = final mean length – initial mean length (cm).

Average daily gain (ADG) g/day = final fish weight/fish – initial fish weight / time in day; Specific growth rate (SGR) = 100 (In. W_2 – In. W_1) / T, these parameter was calculated according to Green *et al*., (2002), where W_1 and W_2 are initial and final weight, respectively and T is number of days in the period. Feed conversion ratio (FCR) = feed intake / weight gain; according to Green *et al*., (2002), Condition factor (K) = weight (g) / length ×100; Relative growth rate (RGR) = total weight gain (g) / initial weight (g) ×100 and Gross yield of fish (GY) = harvested fish weight (kg) pond.

All fish of each treatment pond were harvested and sorted according to size for marketing. Fish yield of each size class was weighted and counted. The size grades of Nile tilapia at harvest and their corresponding market prices / kg are given in Table (3).

Table 3: Size grades of fish Nile tilapia at harvest.

Size grade	Super	1st grade	2nd grade	3rd grade	4th grade
Number /kg	4	4-6	7-9	10-20	>20
Price /kg	10.5	9.5	8.0	6.0	4.5

Chemical analysis of feed and whole fish body:

At the start and end of the experiment 10 fish of each treatment were randomly taken and exposed to proximate composition of dry matter, crude protein, fat and ash according to the methods described by A.O.A.C. (1990). Also, the proximate analysis of the artificial diet was performed according to the same methods. Gross energy of the diet was calculated using values of 5.65, 4.1 and 9.44 kcal/g GE/DM of protein, carbohydrate and lipid, respectively (NRC, 1993).

Water quality:

Water pH was measured every (15 days) using pH meter model 3050 Jenway electrochemical products, range from 0 to 14.Water dissolved oxygen and temperature were measured at (between 9.00 and 9.30 am) each 15 days using Thermo Orion (model 835A, Orion Research Inc.) oxygen meter . Also water samples were taken for analysis of Total ammonia (NH4-N) , nitrate ,nitrite analytical methods were carried out according to the American Public Health Association (APHA, 1985) and salinity Conductivity meter model 4070 Jenway electrochemical product was used to estimate salinity in water samples as ppt/ l.

Plankton determination:

Collection of plankton samples:

Ten litters of water samples were collected from different areas and depths of the ponds every 15 days, and passed through a 25 m mesh plankton net. Collected plankton samples were preserved in 4% buffered formalin in small plastic bottles**.**

Qualitative and quantitative study of plankton:

The preserved plankton samples were counted by using a Sedgwick- Rafter counting cell, under a compound binocular microscope (Swift M 4000-D). A 1 ml sub-sample from each of the samples was transferred to the cells, after which all plankton organisms, present on 10 squares of the cells chosen randomly, were counted and later were used for quantitative estimation using the formula given by Stirling (1985):

$N = (A \times 1000 \times C) / (V \times F \times L)$

Where: N = No. of plankton cells or units per liter of original water; A =Total no. of plankton counted; C = Volume of final concentrate of the samples in ml; V = Volume of a field in cubic mm; F = No. of fields counted; L = Volume of original water in liters.

Plankton were identified up to the category of genus and enumerated according to (APHA, 1992).

Partial budget analysis:

A partial budget analysis was conducted to determine economic returns for the different tested fertilization regimes (Shang, 1976).

Statistical Analysis:

The data was statistically analyzed according to Steel and Torrie (1980) on the collocated data using general linear models procedure adapted by SPSS, (2008) version (16.0) statistical software package (SPSS , Inc ., Chicago , Illinois , USA).

Analysis of variance (ANOVA) and Duncan's post HOC Multiple Comparisons Test was performed to evaluate the differences among treatments means (Duncan, 1955). Differences were considered significant at probability level of 0.05. The statistical model used:

$$Xij=m +Ti + eij$$

Where: - Xij represents the observation; m = overall mean; Ti = effect of treatments; eij = experimental error.

RESULTS AND DISCUSSION

Physio-chemical water quality parameters:

As presented in Table (4) average of water temperatures (^{0}C) in the experimental ponds ranged between 27.55 to 27.64^{0}C, averages of dissolved oxygen (mg/l), pH values: total ammonia (NH_3) mg/l; nitrate (No_{3}-N) mg/l; nitrite (No_{2}-N) mg/l and salinity g/l had ranged between 6.96 and 7.94; 7.26 to 8.31; 0.22 to 0.25; 0.20 to 0.23; 0.12 to 0.15 and 2.20 to 2.25, respectively.

Table 4: Average physical-chemical characteristics of water ponds.

Parameters /Treatment	T1	T2	T3
Water temperature(^{0}C)	27.64	27.60	27.55
Dissolved oxygen (mg/L)	7.94	7.01	6.96
pH value degrees	7.26	7.30	8.31
Total ammonia(NH_3)mg/l	0.25	0.24	0.22
Nitrate (NO_3-N) mg/	0.23	0.22	0.20
Nitrite (NO_2-N) mg/l	0.15	0.12	0.13
Salinity (g/l)	2.24	2.20	2.25

All the tested water quality parameters were within the accepTable levels required for optimum growth and development of Nile tilapia as reported by Boyd (1998) and APHA (1998).

Growth performance:

Results of growth performance parameters are presented in Table (5). Results of this Table show that initial weight (g) and length (cm) of the experimental fish ranged between 19.73 to 20.83g and 5.5 to 6.0cm, respectively and differences in initial weight and length among the experimental groups were insignificant. As presented in the same Table, averages of final weights for T1; T2 and T3 were found to be 241.50; 205.12 and 185.10g, respectively and the statistical evaluation of results indicate the T1 (feed + organic fertilizers) had significantly ($p>0.05$) the highest final weight followed in a significant ($p>0.05$) decreasing order by T2 and T1, respectively. Results of Table (5) show that the highest final length (25.0cm) ($p>0.05$) was recorded by T1 followed in a significant descending order by T2 and T3, respectively.

Table 5: Effect on source of fertilization or artificial feeding on body weights gain, specific growth rate, condition factor and relative growth rate of Nile tilapia (*Oreochromis niloticus*) (Mean±SE).

Treatment groups	T1	T2	T3
Initial weight (I W)	20.83	20.72	19.73
Final weight (FW)	241.50±2.13 ^{a}	205.12±2.33^{b}	185.10±2.12^{c}
Initial length (I L)	6.0	5.83	5.5
Final length (F L)	25.0±0.20 ^{a}	22.10±0.25^{b}	20.83±0.21^{c}
Weight gain (WG)	220.67±2.11 ^{a}	184.40±2.13^{b}	165.37±2.12 ^{c}
Length gain (L G)	19.0±0.42 ^{a}	16.17±0.51^{b}	15.33±0.58 ^{c}
Daily Weight gain (DWG)	1.57±0.05 ^{a}	1.31±0.09^{b}	1.18±0.08 ^{c}
Condition factor (K)	1.54±0.14^{c}	1.92±0.06^{b}	2.04±0.42^{a}
Specific growth rate (SGR)%	1.75±0. 63 ^{a}	1.63±0.12^{b}	1.60±0.10^{b}
Relative growth rate (RGR)	1059.38±2.40 ^{a}	889.96±3.33^{b}	838.16±2.70 ^{c}
Gross yield (GY) kg / pond	3600.0	3001.0	2630.0
As % of the T3 (feed only)	136.28	114.12	100.00

Values within the same row with the same superscript are not significantly different ($P> 0.05$)
T1= Feeding + manure; T2= Feeding + fertilizer (U+TSP); T3 = Feeding

Results of Table (5) reveal also that the T1 recorded significantly ($p>0.05$) the highest values of weight and length gains followed in a significant ($p>0.05$) decreasing order by T2 and T1, respectively. As illustrated in Table (5) average of daily weight gain for the T1, T2 and T3 were 1.57; 1.31 and 1.18g, respectively where the T1 recorded significantly ($p>0.05$) the highest value followed in a significant ($p>0.05$) decreasing order by T2 and T3, respectively. The same trend was observed with results of specific growth rate and relative growth rate were T1 recorded significantly ($p>0.05$) the highest values followed in a significant ($p>0.05$) decreasing order by T2 and T3, respectively.

As presented in the same Table results revealed that condition factor showed the reverse results where T3 had significantly ($p>0.05$) the highest value and T1 had the lowest one which may indicate the fish of T1 grow faster in length relative to the growth in weight. Concerning the fish gross yields kg/pond, results of Table (5) reveals that gross yield of T1, T2 and T3 were 3600.0; 3001.0 and 2630.0 kg/pond, respectively. Gross yield as percentage of the smallest one (T3 feed only) (100%) for T1 and T2 were 136.88 and 114.12%, respectively which indicate that organic manuring with artificial feed improved the growth parameters of Nile tilapia and its final yield in earthen ponds. These results are in accordance with the finding of Hussein and Abdel-Hakim (2003) who reported that manuring of ponds cultured with

Nile tilapia, tilapia aurea, common carp and mullets with chicken manure plus artificial feed improved growth performance of the cultured species compared to ponds received chemical fertilizers. Results presented in Table (5) are also in agreement with the findings of Eid *et al*., (2009) who found that final weight, weight gain, specific growth rate, daily weight gain and gross yield of Nile tilapia were significantly higher received feed plus poultry manure plus urea and triple super phosphate compared to the ponds received feed only. In this respect Abdel-Hakim *et al*. (2013) reported that growth performance parameters of Nile tilapia reared in polyculture ponds and the gross yield recorded significantly the highest values in ponds received artificial feed plus poultry manure and chemical fertilizers (urea + triple super phosphate) compared to ponds received feed only or feed plus poultry manure or feed plus inorganic fertilizers.

Whole body chemical composition:

Results of averages whole body chemical composition including dry matter (DM), protein (CP), ether extract (EE), ash, nitrogen free extract (NFE) and gross energy contents (GE) kcal/100g. Dry matter are presented in Table (6). Results of this Table indicate that DM contents in whole Nile tilapia bodies ranged between 26.05 to 26.65% of the DM with insignificant ($p>0.05$) differences among treatments. As presented in the Table the T1 (feed + poultry manure) showed significantly ($p>0.05$) higher CP contents in whole body dry matter compared to T2 and T3. Furthermore, EE contents in the DM of tilapia whole bodies ranged between, 18.75 to 18.98 percent and differences among the treatment groups were insignificant. Concerning ash contents in Nile tilapia whole bodies, results of Table (6) show that T1 had significant ($p>0.05$) higher values compared to T2 and T3 among both differences in ash contents were insignificant ($p>0.05$). As presented in the same Table T2 and T3 had significantly ($p>0.05$) higher NFE contents compared to T1.

Table 6: chemical composition of the whole body of Nile tilapia *(O.niloticus)*. (Mean±SE).

Item	Treatments	Dry matter	Protein	Ether extract	Ash	Nitrogen free extract**	Gross energy*
Initial		26.30	60.70	18.00	14.50	6.8	537.72
Final	T1	26.05±0.82^{a}	61.89±0.005^{a}	18.75±0. 15^{a}	15.25±0. 15^{a}	4.11±0. 018^{c}	540.43±1. 58^{a}
	T2	26.55±0.45^{a}	60.40±0.40^{b}	18.95±0.15^{a}	14.57±0.17^{b}	6.08±0. 016^{b}	542.04±1. 62^{a}
	T3	26.65±0. 05^{a}	60.15±0.005^{b}	18.98±0.15^{a}	14.60±0.27^{b}	6.27±0. 016^{a}	541.71±1. 59^{a}

Values within the same column with the same superscript are not significantly different ($P> 0.05$)
*GE (gross energy) calculated using the values 4.1 , 5.6 and 9.44 Kcal GE/g DM of carbohydrate , protein and fat, respectively (NRC,1993).
**Nitrogen Free Extract calculated as: 100-% (Moisture Protein + Lipid + Ash + Crude fiber).
T1= Feeding + manure; T2= Feeding + fertilizer (U+TSP); T3 = Feeding

Also, average of contents GE contents in whole fish body (kcal/100g DM) were 540.43; 542.04 and 541.71 for T1; T2 and T3, respectively with differences among the treatment groups in this trait were insignificant. In this respect, Ali (2003) reported that protein and fat contents of the whole tilapia bodies were significantly higher in ponds received mixed fertilizers (chicken manure + inorganic fertilizers) + feed compared to that of fish in ponds received chicken manure with feed. Results of Table (6) concerning ether extract contents are not in accordance with those of Kangombe *et al*. (2006) who stated that *Tilapia rendalli* cultured in ponds received chicken manure had significantly higher body fat compared to cattle manure treatment. Results of Abdel-Hakim *et al*. (2013) are in partial agreement with results of the present study.

There authors reported that Nile tilapia cultured in polyculture system and received artificial feed plus chicken manure and inorganic fertilizers showed significantly higher protein, ether extract, ash contents in their whole bodies compared to treatments received artificial feed only or artificial feed plus poultry manure or artificial feed and inorganic fertilizers. Results of GE contents of tilapia whole bodies are in partial agreement with the findings of Abdel-Hakim *et al*. (2013) who reported that gross energy contents of tilapia whole bodies ranged between 549.91 to 568.84 kcal/100g which is matching with the results of the present study.

Feed conversion ratio (FCR):

Average of initial and final biomass (kg), total gain in biomass (kg) feed intake (kg) and FCR (calculated as kg of feed required for each (kg) gain in weight) are presented in Table (7). Results of this Table show that the initial, final and gain in biomass (kg) of T1; T2 and T3 were 312.45; 310.8 and 295.95 kg, 3600.0; 3001.0 and 2630.0kg and 3287.55; 2690.2 and 2334.05 kg, respectively. Average of amounts of feed consumed during the whole experimental period and the corresponding FCR values for T1;T2 and T3 were 6110.45; 5414.44 and 4676.13 kg and 1.69; 1.80 and 1.77 (kg feed for each kg gain in weight), respectively.

Table 7: Effect of fertilization and feeding on feed conversion ratio of the fish tested.

Treatments	T1	T2	T3
Initial biomass, kg	312.45	310.8	295.95
Final biomass, kg	3600.0	3001.0	2630.0
% of final biomass to T3	136.88	114.10	100
Gain in biomass, kg	3287.55	2690.2	2334.05
%of total final gain to T3	140.85	115.25	100
feed intake, kg	6110.45	5414.44	4676.13
FCR	1.69	1.80	1.77

T1= Feeding + manure; T2= Feeding + fertilizer (U+TSP); T3 = Feeding

The results indicate that rearing tilapia in earthen ponds using artificial feed with poultry manure improved the FCR followed by feeding only and with feeding plus inorganic fertilizers. These results are in agreement with the findings of El-Tawil (2006), who reported that the best FCR values of Nile tilapia were obtained using compost as fertilizer followed by fish reger as organic fertilizer, super phosphate + urea while using artificial feed only resulted in the highest FCR values. Results of Abdel-Hakim *et al*. (2013) showed that the best FCR values obtain from ponds cultured with tilapia, mullet and common carp were that of ponds received artificial feed plus inorganic fertilizers followed by ponds received artificial diet plus poultry manure and inorganic fertilizers, then those received artificial feed only or artificial feed plus poultry manure.

Nitrogen inputs utilization:

Nitrogen inputs utilization in form of diet nitrogen, chicken manure nitrogen added as fertilizer and urea nitrogen supplied during the whole experimental period are presented in Table (8). Average total nitrogen inputs, for T1; T2 and T3 were found to be 259.93; 242.54 and 169.31 kg/pond, respectively. These results indicate that highest nitrogen inputs were recorded by the T1 (feeding + chicken manure) followed in a descending order by T2 feeding + chemical fertilizers) and T3 which received only feed without any fertilizers, respectively. The nitrogen gained in the harvested fish (kg) for T1; T2 and T3 were 92.86; 76.99 and 76.45 kg, respectively which indicate that T1 due to higher pond fish production gained were nitrogen followed in a decreasing order by T2 and T3, respectively. The T3 showed the lowest nitrogen gain in the harvest which reflects the importance of fertilization in bloom and development of natural food in ponds for the cultured fish. Average of nitrogen wasted in the environmental (kg) in T1; T2 and T3 were 167.07; 165.55 and 101.86 kg, respectively. These results may indicate that fertilization either with chicken manure or with chemical fertilizers of the applied rates may be more than enough to satisfy the fish needs from the natural food. The higher nitrogen waste to the environment may due also to higher nitrogen secretion of T1 and T2 due to its higher biomass compared to T3 that received artificial food only. The averages of nitrogen utilization (kg) of nitrogen gained in fish bodies / total nitrogen inputs × 100) for T1; T2 and T3 were 35.72; 31.74 and 39.83%, respectively.

Table 8: Nitrogen inputs in the forms of fertilizer and feed, gain in the form of harvested biomass, and waste generated from various treatments over culture period.

Treatments	T1	T2	T3
Nitrogen Input (Kg/pond)			
Manure	38.69	-	-
Urea	-	46.5	-
Sum in Fertilizers	38.69	46.5	-
Feed	221.24	196.04	169.31
Total N input	259.93	242.54	169.31
Nitrogen Output			
N gained in harvest	92.86	76.99	76.45
Waste to environment	167.07	165.55	101.86
Nitrogen utilization	35.72	31.74	39.83
Total fish production	3600.0	3001.0	2630.0
As % of the T3 (feed only)	136.28	114.12	100.00

T1= Feeding + manure; T2= Feeding + fertilizer (U+TSP); T3 = Feeding

These results indicate that the highest nitrogen utilization ratio was obtained by T3 (feed only) followed descendingly by T1 and T2, respectively. These results indicate that feeding tilapia only in earthen ponds without any fertilization improved the nitrogen utilization compared to treatments fertilized either with chicken manure or inorganic fertilizers. The lower nitrogen utilization records of T1and T2 (receiving fertilizers plus feeding) may due to the fact that both treatments wasted higher amounts of nitrogen in the environment compared to T1. The T1 receiving only artificial feed may have some of the atmospheric nitrogen which converted to plankton organisms which is also consumed by fish in this treatment. This finding is supported by the findings of Boyd (1979) who showed that atmospheric nitrogen is soluble in water to the extent of about 12 mg/liter at 25^0C. Other inorganic forms of nitrogen in the usual order of increasing abundance are NO_2, NH_3, NO_3 and NH_4. The results concerning nitrogen utilization are in partial agreement with the findings of Abdel-Hakim *et al.* (2013), who reported that nitrogen utilization records of poly culture ponds that received feed only; feed + poultry manure, feed plus poultry manure and inorganic fertilizers and feed + inorganic fertilizers were 35.56; 32.18; 33.81 and 35.90%, respectively. In this respect Mohamed (2010), reported that ponds cultured with Nile tilapia and silver carp received artificial feeds plus cow manure or urea + triple super phosphate showed higher nitrogen gain (37.63 and 38.26 kg nitrogen /feddan), respectively compared to ponds received feed plus compost only or ponds received artificial feed plus cow manure only (34.0 and 34.2 kg nitrogen /feddan), respectively. Plankton abundance; plankton population in the experimental ponds comprised of six groups consisting of 36 genera as presented in Table (9). The total planktonic organisms mainly composed of 4 groups of phytoplankton and 2 groups of zooplankton. Some of 19 genera of phytoplankton belong to Chlorophyceae (7); Cyanobacteria (5); Bacillariophyceae (5) and Euglenophyceae (2) were identified. Eight genera of zooplankton were also identified belonging to Crustacea (4) and Rotifera (4) Table (9).

Table 9: Generic status of Phyto and Zooplankton available in pond waters during experimental period.

Phytoplankton		Zooplankton
Chlorophyceae *Chlorella* *Scenedesmus* *Actinastrum. sp* *Pleurotaenium. sp* *Coilastrum* *Ankistrodesmus* *Pediastrum* **Cyanobacteria** *Anabaen* *Chroococcus* *Oscillatoria*	*Microcystis* *Gleocapsa* **Bacillariophyceae** *Navicula* *Nitzschia* *Pinnularia* *Melosira* *Cyclotella* **Euglenophyceae** *Euglena* *Phacus*	**Rotifers** *Asplanchna* *Brachionus* *Keratella* *Nothoica* **Crustacea** *Cladocera* *Copepods* *Daphina* *Nauplius*

As present in Table (10) highest total phytoplankton counts (org/ml) were recorded by T1 (feeding + poultry manure), while the lowest count of phytoplankton was recorded by T3 (feeding only). The same trend was observed with the total zooplankton count where T1 recorded the highest count (683 org./ml) followed by T2 (468 org./ml) and T3 (288 org./ml), respectively. These results indicate that manuring tilapia ponds with chicken manure improve drastically the phyto and zooplankton communities in tilapia ponds followed by inorganic fertilization and ponds receiving only feed without fertilization respectively. These results are in accordance with the findings of Begum *et al*. (2007) who showed that manuring fish ponds with poultry manure or cow manure plus urea and triple super phosphate had showed the highest abundance ($\times 10^4$ cells/l) of Chlorophyceae, Cyanobacteria; Bacillariophyceae; Euglenophyceae and total phytoplankton counts compared to received fertilization only or feed only. Results of the present study are also in accordance with the results of Hussain *et al*. (2006) who reported that ponds fertilized with poultry manure showed higher Crustacea, Rotifers and total zooplankton counts compared to ponds received cow manure or those received urea + triple super phosphate. Furthermore, results of Abdel-Hakim *et al*. (2013) are in accordance with the results of the present study. The authors reported that the highest plankton counts were recorded in fish ponds receiving artificial feed + poultry manure, artificial feed + poultry manure and inorganic fertilizers and ponds receiving artificial feed + inorganic fertilizers compared to ponds receiving artificial feed only.

Effect of the treatments on pond costs and returns:

Results of financial inputs included fingerlings, fertilizers and feed total costs are presented in Table (10). Results of this Table reveal that findings Nile tilapia costs were similar for all treatment ponds which were 600 LE for each 15000 fish. As present in the same Table the total costs of organic fertilizers used T1 and inorganic fertilizers T2 were 1015.0; and 500 LE, respectively, while their were no costs for these items in T3 which received no fertilization. These results indicate that application of organic fertilization costed two folds than the inorganic fertilization. Total feed costs for T1; T2 and T3 were 17109.26; 15160.43 and 13093.16 LE, respectively and differences in total feed costs had due to differences in fish weights and consequently in total biomass, thus all fish in the applied treatments were fed at a rate of 3% of pond fish biomass. Results of the same Table reveal that the total running costs (fertilizers + feeds + fry) for T1; T2 and T3 were 18724.26; 16260.43 and 13693.16 LE, respectively.

Table 10: Costs and returns of the applied treatments.

Item		T1	T2	T3
Total costs15000 fingerlings 40 LE/ 1000		600.0	600.0	600.0
Feeds: amount price 2.80LE/ kg		17109.26	15160.43	13093.16
Fertilizers:				
1- Organic amount Price (0.58LE/kg)		1015.0		
2- Inorganic				
- Urea amount Price (2.50 LE/kg)		-	250.0	-
-Triple Super phosphate amount Price (1.25 LE/kg)		-	250.0	-
Total fertilizer costs		1015.0	500.0	-
Total costs LE		18734.26	16260.43	13693.16
Fish grades	Price/kg	Production kg/pond	Production kg/pond	Production kg/pond
Nile tilapia grades production (kg/pond)				
Supper grade (4/kg)	10.5	1875.0	320.0	200.0
1st grade (4-6 /kg)	9.5	950.0	1609.0	1400.0
2nd grade (7-9 /kg)	8.0	525.0	350.0	475.0
3rd grade (10-20/kg)	6.0	200.0	450.0	210.0
Others >20	4.5	50.0	150.0	295.0
Total yield		3600.0	3001.0	2630.0
Returns tilapia amount kg x Price (LE/kg)		34337.5	24820.5	21787.5
Net returns (LE)*		15613.24	8560.07	8094.34
% of T3		192.89	105.75	100

*Net returns = production LE – total costs

T1= Feeding + manure; T2= Feeding + fertilizer (U+TSP); T3 = Feeding

Concerning the returns in form of fish sales according to fish grades are presented in Table (10). The sale prices of fish grades super grade (4fish/kg); grade 1 (4-6fish/kg); grade 2 (7-9fish/kg); grade 3 (10-20fish/kg) and others > 20fish/kg were 10.5; 9.5; 8.0; 6.5 and 4.5 LE, respectively. As presented in the same Table average of sale prices of the produced fish for T1; T2 and T3 were 34337.5; 24820.5 and 21787.5 LE, respectively, while the net returns for the same groups cited above were 15613.24; 8560.07 and 8094.34 LE, respectively. These results indicate that application of organic fertilization with artificial feeding of Nile tilapia reared in earthen ponds increased the net returns compared to T3 by 92%, while application of chemical fertilizers increased the net returns only by 5% are T3. These results are in accordance with Abdel-Hakim *et al*. (2013).

CONCLUSION

Based on the obtained results it is recommend to rear of monosex Nile tilapia in earthen ponds fertilized with chicken manure plus artificial feeding for better growth performance, total yield and net returns.

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ARABIC SUMMERY

أثر نوعية التسميد مع التغذية الصناعية على أداء النمو وجودة المياه والعائد الاقتصادي للبلطي النيلي وحيد الجنس المربى في احواض ترابية.

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تم تنفيذ هذه الدراسة في مزرعة اسماك خاصة بمنطقة طلمبات ٧- محافظة كفر الشيخ – مصر. هدفت الدراسة الى تقدير تأثير نوعية التسميد المختلفة والتغذية الصناعية على أداء النمو والاستفادة من النيتروجين والغذاء المضاف الى الاحواض والتركيب الكيميائي للجسم وجودة المياه وكثافة البلانكتون والتقييم الاقتصادي لإنتاجية الاحواض الترابية المستزرعة بالبلطي النيلي وحيد الجنس. أجريت الدراسة في احواض ترابية بمساحة كلية قدرها ١،٢٥ فدان لكل معاملة وعمود مياه ١،٢٥ متر. تمت الدراسة في إطار ثلاث معاملات:-
المعاملة الأولى: تسميد عضوي بزرق الدواجن بمعدل ٨٧،٥ كيلو جرام/حوض اسبوعيا مع تغذية بالغذاء الصناعي(٢٥% بروتين)- المعاملة الثانية:التغذية الصناعية بنفس العلف المستخدم في المعاملة الاولى+ تسميد غير عضوي (كيماوي) بمعل ٥ كجم يوريا ٤٦،٥ نتروجين + ١٠ كجم تربل سوبر فوسفات / حوض اسبوعياً – المعاملة الثالثة : عذاء صناعي فقط دون اضافة اي تسميد للحوض. والغذاء الصناعي لجميع المعاملات تم اضافتة بمعدل ٣% من الكتلة الحية الكلية بالاحواض وكانت تعدل اسبوعياً حسب متوسط وزن الأسماك على مرتين في اليوم التاسعة صباحاً والثالثة ظهراً. تم تسكين كل حوض من احواض التجربة بـ ١٥٠٠٠ من أصبعيات سمك البلطي وحيد الجنس بمتوسط وزن اولي يتراوح مابين ١٩،٧٣ و ٢٠،٨٣ جرام ومتوسط طول يتراوح مابين ٥،٥ – ٦،٠ سم – واستمرت الدراسة ١٨ اسبوع من البداية في اغسطس وحتى ديسمبر ٢٠١٢ م والنتائج المتحصل عليها تتلخص في الاتي:
١ – اظهرت نتائج قياسات جودة المياه (درجة حرارة الماء ، الاكسجين الذائب ملجم/لتر، قيم الأس الهيدروجينى pH ، الامونيا الكلية ملجم/لتر ، النترات ملجم/لتر ، النيتريت ملجم/لتر والملوحة جرام/لتر) كانت في الحدود المثلى لنمو أسماك البلطي النيلي.
٢- الوزن النهائي والطول ، الزيادة في الوزن ، الزيادة في الطول ، الزيادة اليومية في الوزن، معدل النمو النسبي و RGR في المعاملة الاولى (غذاء + تسميد عضوي) سجلت النتائج معنوية عالية في هذه القيم تبعتها بمعنوية منخفضة المعاملة الثانية (تغذية + تسميد غير عضوي أو كيماوي) ثم المعاملة الثالثة (تغذية فقط) على التوالي.
٣- أظهرت النتائج أن أفضل كفاءة تحويل غذائي سجلت في المعاملة الاولى تبعتها الثالثة ثم الثانية على التوالي
٤- المعاملات المختبرة اظهرت تأثيراً معنوياً على التحليل الكيميائي لجسم الأسماك الكلي.
٥- متوسط الاستفادة من النتروجين (النتروجين الزائد في جسم الأسماك / النتروجين الكلي الداخل × ١٠٠) كانت النتائج ٣٥،٧٢ ، ٣١،٧٤ و ٣٩،٨٣ للمعاملة الأولى والثانية والثالثة على التوالي.
٦- اظهرت المعاملة الأولى أعلى انتاجية في الأسماك تبعتها المعاملة الثانية والثالثة على التوالي.
٧- اظهرت كذلك المعاملة الاولى أعلى عائد اقتصادي (١٥٦١٣،٤٢ جنية مصري) مقارنة بالمعاملة الثانية (٨٥٦٠،٠٧ جنية) والمعاملة الثالثة (٨٠٩٤،٣٤ جنية).