Vet.Med.J.,Giza. Vol.47, No.2. (1999) :167-183.

# EFFECT OF POND FERTILIZATION AND RECRUITMENT OF NILE TILAPIA *(OREOCHROMIS NILOTICUS)* ON THEIR PERFORMANCE AND FEED COMPETITION

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Received: 7.7.1998.
Accepted: 22.11.1998.

## SUMMARY

Six earthen ponds were stocked by Nile tilapia *(Oreochromis niloticus)* fingerlings at a rate of two fish per square meter for 229 days. The experiment was conducted at Fish Research Station at El-Kanater El-Khairia which belongs to National Institute of Oceanography and Fisheries.

The experiment was conducted using factorial design (2x3). The treatments were divided into three gorups, all male tilapia were cultured separately, males were cultured together with females removing about 80% of their fry during the growing season and males were cultured with females also, but their fry were not removed. The three treatments were performed in fertilized and unfertilized pounds. All groups received artificial diet (30% protein) at a rate of 3% from fish live body weight.

The results showed that the highest growth rates, protein utilization values, frequency occurrence (FO) and percentage composition (PC) values were achieved when all male tilapia were cultured separately in fertilized pounds.

In case of male culture together with females, the highest growth rates, protein utilization values, FO and PC values were recorded when 80% of tilapia's fry were removed during the growing season in fertilized pounds.

In conclusion, culture of all male tilapia should be conducted, but the techniques of all male tilapia pond management can't be fine tuned". When males were cultured together with females, the chemical fertilizers with optimum doses should be used, because it is largely related to the abundance and type of food available to fry in order to avoid feed competition.

## INTRODUCTION

In Egypt, tilapia are one of the most important aquaculture species and are gaining popularity as food fish. Till now, there are many problems still facing tilapia culture pond systems in Egypt. One of the problems is that tilapia (*Oreochromis niloticus*) become mature at 9-12cm (Bishara, 1973), then the adult tilapia spend energy and metabolic reserves in reproduction rather than growth. When the viable spawn and good hatching success occurred the gradual increase of fry can result in over population and stunting of fish in earthen ponds. This gradual increase is largely related to the abundance and type of food available to fry. Hence, growth rate and production are greatly harmed. Researchers have recommended the culture of male tilapia as a solution to this problem (Hepher and Pruginin, 1982; Alvarenga and Green, 1989 and Green, 1992). When males and females stocked together, we came to another solution, which is the chemical fertilizers for enhancing pond production by sparing the abundance and type of food available to fry. It has been conclusively demonstrated by many investigators that phosphorous and nitrogen are the most important nutrient supplements usually present in minimal supply. Yamada, (1986). Toulaiabha, (1992) and Shehata et al., (1994) have demonstrated that tilapia (*Oreochromis niloticus*) production increased when nitrogen and phosphorous fertilizers were used rather than other fertilizers.

Therefore, the present work was conducted to evaluate monosex tilapia (*Oreochromis niloticus*) culture technique and the influence of chemical fertilizers on growth of male tilapia stocked separately, males stocked together with females removing about 80% of their fry during the growing season and males cultured together with females also, but their fry were not removed.

## MATERIALS AND METHODS

### 1- Experimental Fish:

Tilapia (*Oreochromis niloticus*) initial weight 26.93 + 1.11 gm were collected from the common population in Fish Culture Research Station at El-Kanater El-Khairia which belongs to the National Institute of Oceanography and Fisheries.

### 2- Culture technique:

The fingerlings were collected randomly and transferred to six earthen ponds stocked at a rate of two fish per square meter for 229 days, from 12, April to 27, November (Table 1). The experiment was conducted using factorial design (2x3). The treatments were divided into three gorups, all male tilapia were cultured separately, males were cultured together with females (1:3) removing about 80% of their fry (by using suitable net every 15 days) during the growing season and males cultured with females (1:3) also, but their fry were not removed. The three treatments were conducted in fertilized and unfertilized ponds.

Table (1): Sex ratio (Female: Male) of tilapia (*Oreochromis niloticus*) reared in earthen ponds.

| Items | Fertilized ponds | | | Unfertilized ponds | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| Stocking rate (Fish/ha) | 19372 | 19833 | 19388 | 19403 | 19587 | 19733 |
| Male (Fish/ha) | 19372 | 4958 | 4788 | 19403 | 4854 | 4876 |
| Female (Fish/ha) | -- | 14875 | 14600 | -- | 14733 | 14857 |
| Sex ratio (Female: Male) | (0:1) | (3:1) | (3:1) | (0:1) | (3:1) | (3:1) |

In ponds No. 1&4 only males were cultured.
In ponds No. 2&5 males were cultured together with females and about 80% of their fry were removed during the growing season.
In ponds no. 3&6 males were cultured together with females and their fry were not removed during the growing season.

Table (2): Feed formulation and chemical composition of the experimental diet

| Ingredient | % |
|---|---|
| Wheat bran | 39 |
| Fish meal | 30 |
| Meat meal | 27 |
| Vit. Min. Premix* | 1 |
| Cotton seed oil | 3 |
| <u>Chemical Composition:</u> | |
| Crude protein, % | 30.00 |
| Ether extract, % | 8.11 |
| Crude fiber, % | 6.27 |
| Ash | 11.29 |
| Nitrogen free extract, % | 44.33 |
| Gross energy (K Cal/Kg diet) | 4500.00 |

* Vitamins and Mineral mixture each IKg of mixture contains: 4.8 m. I.U. Vit. A., 0.8m. I.U. Vit. D3, 4.0 gm. Vit. E, 0.8 gm. Vit. K., 4.0 gm. vit. B2, 0.6gm. Vit. B6, 4.0 gm. Vit. Pantothenic acid, 8.0 gm. Vit. Nicotinic acid, 400 mg. Vit. Folic acid, 20 mg. Vit. Biotin, 20 gm. Choline choride, 4.0 gm Copper, 04 gm. Iodine, 12 gm. Iron 22gm. Manganese, 22gm. Zinc, 0.04 gm selecnium.

### 3- Supplementary feeding:

The composition of the fish diet is presented in table (2). The diet was formulated so that nutrients content equalled or exceeded the known nutritional requirements of tilapia (*Oreochromis niloticus*) (Jauncey and Ross, 1982). Minimum and maximum nutrients restrictions were considered for crude or digestible protein and digestible energy (NRC, 1977) digestibility coefficients and actual ingredient analysis and for available phosphorous {from data of Lovell (1977)}. Total calcium and essential amino acid composition (NRC, 1977). Selection of nutrient and ingredient restrictions followed puplished recommendations for tilapia and other species. Ingredients included a complete vitamin and trace mineral premix formulated according to NRC (1977) specifications, preservatives and pellet binder in formula. The experimental diet was fed in a pelleted from at a rate of 3% of the fish biomass in each pond. The experimental diet was fed once daily at 10 A.M. for sex days weekly.

### 4- Determination of the optimum doses of phosphorous and nitrogen:

The experimental ponds were fertilized by super phosphate as a source of phosphorous and urea as a source of nitrogen. The fertilization programme of these ponds were carried out after determination of limiting fertilizers and optimum concentration required for increasing primary productivity to maximum level according to Toulaibeh, (1992). This was achieved by adding a known doses of nitrogen and phosphorous fertilizers bottles to a known volume of natural water in 300 ml BOD (Biological Oxygen Demand). The expermental bottles as well as the control bottel were incubated for 2 hours just below the water surface under conditions. The dissolved oxyegen of test bottles at time zero and after incubation was determined according to modified Winkler's method (APHA, 1993). This limiting fertilizer and its optimum concentration that gave maximum net production was added taking into consideration the volume of the water in each pond.

### 5- Techniques used to investigate stomach content:

Fish were taken every two weeks from each treatment two hours post feeding and kept in fiberglass tanks having a running water volume of 1 $m^3$. The technique has to investigate the movement of food through fish stomach and intestine was the recovery of stomach contents by sfaughter after a voluntary meal (Brett and Higgs, 1970; Elliott, 1972; Peters and Hoss, 1974). The wet weights of 20 stomach contents were determined, and all stomach contents were washed and examined in the laboratory using binocular microscope to investigate the natural food. The different food items constituting the plant and animal materials were identified and counted by Sedwick Rafter Counting Cell (for counting the phytoplankton), and Try Counting Cell (for counting zooplankton). The obtained data were analysed by the following methods:

**a- Occurrence method:**

This method is known as frequency occurrence (FO) where

FO=No. of stomach containing the food item/ total No. of examined stomach.

**b- Numerical method:**

This method is indicated as percentage occurence (PC), where,

PC = 100*No* of food item in stoach / No. of all items in the stomach.

**6- Physicochemical characteristics of pond's water:**

The water was taken from El-Menoufy canal (branch of the river Nile). It was soft and slightly acidic. The conductivity at 2°C was about 0.24 to 0.30 mS/m and the pH values varied between 6.3 and 8.1. All tilapia were exposed to the annual temperature fluctuations of the River Nile (Table 3).

**7- Statistical analysis:**

Statistical analysis was carried out after Steel and Torrie (1980) using factorial design (2x3). Duncan's test was applied in the experiment whenever possible to test mean differences (Duncan, 1955).

## REESULTS AND DISCUSSION

**1- Culture of all male tilapia:**

The average performance data of all male tilapia *(O. niloticus)* are shown in tables (4.5 and 6). The resutls showed that the growth rate of fish reared in fertilized ponds was higher than those reared in unfertilized ones. In the present state, the daily gain of fish reared in fertilized ponds was high compared with Loveshin et al. (1974) finding (0.96 gm/day) which was achieved in monosex culture of male tilapia *(Oreochromis niloticus)* without using fertilizers. Vernal et al. (1983) found that the daily growth rates ranged between 0.80 to 1.11 gm/day on intensive fish culture of all male tilapia without using fertilizers. Recently, Salama and Abd-ElRaheem (1995) reported that the daily growth rates was 1.15 gm/day without using fertilizers when monosex was evaluated. The high growth rate in the present state is largely related to the use of chemical fertilizers.

As shown in table (6), he daily yield of fish reared in fertilized ponds was 45.41 kg/ha. This value was higher than that obtained by Schroder et al., (1990) who studied the effect of daily organic manuring plus chemical fertilizers on tilapia (Oreochromis niloticus). They found that the daily yields were 29.5 kg/ha in organically manured ponds and 27.2kg/ha in chemically fertilized ponds. The data indicated that the fetilizaiton

Table (3): Physicochemical characteristics of earthen pond water during the experimental period

| Criterion | | Ammonia (mg./L) | Dissolved Oxygen (mg./L) | PH | T°C |
|---|---|---|---|---|---|
| April, 12 | | 0.25 | 6.20 | 7.24 | 20.3 |
| | ± SE | 0.02 | 0.73 | 0.81 | 0.36 |
| April, 27 | | 0.27 | 5.71 | 7.58 | 22.3 |
| | ± SE | 0.03 | 0.81 | 0.66 | 0.36 |
| May, 12 | | 0.27 | 5.80 | 7.97 | 22.7 |
| | ± SE | 0.04 | 0.77 | 0.67 | 0.41 |
| May, 27 | | 0.28 | 5.83 | 7.50 | 22.4 |
| | ± SE | 0.01 | 0.80 | 0.73 | 0.52 |
| June, 11 | | 0.29 | 6.00 | 7.73 | 25.1 |
| | ± SE | 0.03 | 0.62 | 0.65 | 0.31 |
| June, 26 | | 0.29 | 5.77 | 7.30 | 25.3 |
| | ± SE | 0.05 | 0.66 | 0.62 | 0.37 |
| July, 11 | | 0.30 | 3.24 | 8.00 | 27.4 |
| | ± SE | 0.01 | 0.88 | 0.81 | 0.12 |
| July, 26 | | 0.31 | 4.29 | 7.53 | 28.2 |
| | ± SE | 0.04 | 0.95 | 0.72 | 0.51 |
| August, 10 | | 0.30 | 5.55 | 7.00 | 29.5 |
| | ± SE | 0.07 | 0.81 | 0.65 | 0.11 |
| August, 25 | | 0.30 | 6.00 | 7.88 | 29.3 |
| | ± SE | 0.03 | 0.74 | 0.88 | 0.27 |
| September, 9 | | 0.30 | 6.21 | 8.11 | 29.7 |
| | ± SE | 0.05 | 0.91 | 0.81 | 0.20 |
| September, 24 | | 0.24 | 6.00 | 7.61 | 30.3 |
| | ± SE | 0.03 | 0.85 | 0.66 | 0.33 |
| October, 9 | | 0.26 | 5.34 | 7.61 | 27.2 |
| | ± SE | 0.01 | 0.80 | 0.75 | 0.37 |
| October, 24 | | 0.29 | 6.00 | 7.61 | 25.7 |
| | ± SE | 0.06 | 0.83 | 0.81 | 0.17 |
| November, 8 | | 0.29 | 6.11 | 7.50 | 25.0 |
| | ± SE | 0.02 | 0.91 | 0.78 | 0.20 |
| November 23 | | 0.28 | 5.95 | 7.13 | 24.2 |
| | ± SE | 0.04 | 0.62 | 0.66 | 0.38 |

SE: The Standard Error (Calculated from residual mean).

Table (4): The average performance of tilapia *(Oreochronis niloticus)* reared in earthen ponds.

| Items | Treatments | | | | | | ± SE |
|---|---|---|---|---|---|---|---|
| | Fertilized ponds | | | Unfertilized ponds | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | |
| Initial body weight (gm) | 28.27 | 25.33 | 29.38 | 20.20 | 28.30 | 30.11 | 1.50 |
| Final body weight (gm) | 621.36$^{a}$ | 371.20$^{bc}$ | 193.44$^{de}$ | 405.00$^{b}$ | 216.67$^{d}$ | 150.00$^{ef}$ | 72.12 |
| Specific growth rate (% day) | 1.35$^{a}$ | 1.17$^{bc}$ | 0.82$^{e}$ | 1.02$^{b}$ | 0.89$^{de}$ | 0.70$^{f}$ | 0.10 |
| Gain per fish (gm) | 593.09$^{a}$ | 345.87$^{bc}$ | 164.06$^{e}$ | 378.80$^{b}$ | 188.37$^{de}$ | 119.89$^{ef}$ | 72.47 |
| Feed consumption per fish (gm) | 599.00$^{a}$ | 577.60$^{ab}$ | 352.73$^{f}$ | 452.56$^{c}$ | 423.66$^{ed}$ | 407.63$^{de}$ | 40.13 |
| Feed conversion (gm/gm) | 1.01$^{a}$ | 1.67$^{c}$ | 2.15$^{e}$ | 1.01$^{ab}$ | 2.25$^{de}$ | 3.40$^{ef}$ | 0.35 |

In ponds No. 1 &4 only males were cultured.
In ponds No. 2&5 males were cultured together with females and about 80% of their fry were removed during the growing season.
In ponds No. 3&6 males were cultured together with females and their fry were not removed during the growing season.
Specific growth rate = Ln of Final body weight-Ln fo Initial body weight/period (day)* 100
Feed conversion = feed intake (gm)/ weight gain (gm)
SE= the Standard error (calculated from the residual mean
a,b ...etc. measns in same raw with different superscriptss are different ($P \leq 0.05$).

Table (5): The effect of fertilization regardless the culture type and vice versa on the average performance of tilapia *(Oreochromis niloricus)* reared in earthen ponds.

| Items | Treatments | | | | | | |
|---|---|---|---|---|---|---|---|
| | Effect of fertilization irrespective of the culture type | | | Effect of the culture type irrespective of the fertilization | | | |
| | Fertilized ponds | Unfertilized ponds | ± SE | Only Males | Males+Females (80% fry were removed) | Males+Females (their fry not removed) | ± SE |
| Initial body weight (gm) | 27.66 | 26.00 | 0.73 | 24.24 | 26.82 | 29.75 | 1.59 |
| Final body weight (gm) | 395.33$^{a}$ | 257.22$^{b}$ | 69.06 | 513.18$^{a}$ | 293.94$^{b}$ | 171.72$^{c}$ | 99.89 |
| Specific growth rate (% day) | 1.11$^{a}$ | 0.93$^{b}$ | 0.09 | 1.28$^{a}$ | 1.03$^{b}$ | 0.76$^{c}$ | 0.15 |
| Gain per fish (gm) | 367.67$^{a}$ | 229.02$^{b}$ | 69.33 | 485.95$^{a}$ | 267.12$^{b}$ | 141.98$^{c}$ | 100.51 |
| Feed consumption per fish (gm) | 509.58$^{a}$ | 509.78 | 0.10 | 525.78$^{a}$ | 500.63$^{ab}$ | 380.18$^{c}$ | 44.93 |
| Feed conversion (gm/gm) | 1.61$^{a}$ | 2.28$^{b}$ | 0.34 | 1.01$^{a}$ | 1.96$^{b}$ | 2.78$^{c}$ | 0.49 |

SE = the standard error (calculated from the residual mean)
a,b, ....etc. means in smae raw with different superscriptss are different ($P \leq 0.05$).

Table (6): Production data of cultured fish in earthen ponds.

| Items | Fertilized ponds | | | | | | Unfertilized ponds | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | |
| | Quantity (Kg/ha) | % | Quantity (Kg/ha) | % | Quantity (Kg/ha) | % | Quantity (Kg/ha) | % | Quantity (Kg/ha) | % | Quantity (Kg/ha) | % |
| Grade I (≤ 2-4 Fish/Kg) | 10400 | 100 | 1339.11 | 29.66 | 939.87 | 28.92 | 10000 | 100 | 904.76 | 23.87 | 821.43 | 28.65 |
| Grade II (≤ 5-8 Fish/Kg) | - | - | 1509.25 | 33.43 | 898.74 | 27.65 | - | - | 1327.38 | 35.03 | 720.00 | 25.10 |
| Grade III (≤ 12-15 Fish/Kg) | - | - | 1666.30 | 36.91 | 1411.22 | 43.42 | - | - | 1557.43 | 41.10 | 1326.11 | 46.25 |
| Daily yield of fish (Kg/ha) | 45.41 | - | 19.71 | - | 14.19 | - | 43.67 | - | 16.55 | - | 12.52 | - |
| Total production (Kg/ha) | 10400 | - | 4514.66 | - | 3249.83 | - | 10000 | - | 3789.57 | - | 2867.54 | - |

In ponds No. 1 & 4 only males were cultured.
In ponds No. 2 & 5 males were cultured together with females and about 80% of their fry were removed during the growing season.
In ponds No. 3 & 6 males were cultured together the females and their fry were not removed

Table (7): Protein efficiency ratio Protein productive value and Net protein utilization values of tilapia *(Oreochromis niloticus)* reared in earthen ponds.

| Items | Treatments | | | | | | ±SE |
|---|---|---|---|---|---|---|---|
| | Fertilized ponds | | | Unfertilized ponds | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | |
| Protein efficiency ratio* | 3.19$^{a}$ | 1.89$^{c}$ | 1.32$^{e}$ | 2.78$^{b}$ | 1.45$^{de}$ | 0.96$^{f}$ | 0.36 |
| Protein productive value** | 42.57$^{a}$ | 21.57$^{c}$ | 14.32$^{de}$ | 33.33$^{b}$ | 17.64$^{ed}$ | 11.71$^{ef}$ | 4.91 |
| Net protein utilization*** | 10.39$^{a}$ | 8.19$^{c}$ | 6.53$^{c}$ | 9.22$^{b}$ | 7.41$^{d}$ | 5.17$^{f}$ | 0.77 |

In ponds No. 1 & 4 only males were cultured.
In ponds No. 2 & 5 males were cultured together with females and about 80% of their fry were removed during the growing season.
In ponds No. 3 & 6 males were cultured together the females and their fry were not removed during the growing season.
* - RER = Body weight gain (g)/ protein intake (g)
**- pPV = Final Total body protein - Initial body protein divided by total deitary protein consumed x100
***- NPU = Final body protein 1(g)- Final body protein 2(g)/ protein intake (g)
(1): Protein diet group; 2: Non protein diet group)
SE = The standard error (calculated from the residual mean).
a,b,... etc. means in same raw with different superscriptss are different ($p \leq 0.05$).

Table (8): The effect of fertilization regardless the culture type and vice versa on Protein efficiency ratio. Protein productive value and net protein utilizaiton of tilapia *(Oreochromis niioticus)* reared in earthen ponds.

| Items | Treatments | | | | | | |
|---|---|---|---|---|---|---|---|
| | Effect of fertilization irrespective of the culture type | | | Effect of the culture type irrespective of the fertilization | | | |
| | Fertilized ponds | Unfertilized ponds | ± SE | Only Males | Males+Females (80% fry were removed) | Males+Females (their fry not removed) | ± SE |
| Protein efficiency ratio | 2.13$^{a}$ | 1.73$^{b}$ | 0.20 | 2.99$^{a}$ | 1.67$^{b}$ | 1.14$^{bc}$ | 0.55 |
| Protein productive value | 25.99$^{a}$ | 20.89$^{b}$ | 2.55 | 37.95$^{a}$ | 19.37$^{b}$ | 13.02$^{c}$ | 7.48 |
| Net protein utilization | 8.37$^{a}$ | 7.26$^{b}$ | 0.24 | 6.53$^{a}$ | 5.20$^{b}$ | 3.90$^{c}$ | 0.59 |

SE = The standard error (calculated from the residual mean).
a,b,... etc. means in same raw with different superscriptss are different ($p \leq 0.05$).

Table (9): The average number of Phylo-zooplankton in gut of tilapia *(Oreochromis niloticus)* reared in earthen ponds.

| Items | Treatments | | | | | | ±SE |
|---|---|---|---|---|---|---|---|
| | Fertilized ponds | | | Unfertilized ponds | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | |
| Phytoplankton:- | | | | | | | |
| *Chrysophyta* | 853[a] | 771[b] | 524[d] | 617[c] | 509[de] | 423[f] | 67.66 |
| *Chlorophyta* | 2200[a] | 1929[b] | 1811[c] | 1789[cd] | 1514[e] | 1333[f] | 124.95 |
| *Cyanophyta* | 3879[a] | 324[b] | 266[d] | 291[bc] | 210[e] | 178[ef] | 31.04 |
| Zooplankton:- | | | | | | | |
| *Cilliata* | 319[a] | 289[b] | 188[e] | 241[c] | 196[ed] | 162[ef] | 25.19 |
| *Rotifera* | 287[a] | 212[c] | 188[d] | 243[b] | 183[de] | 159[f] | 18.98 |
| *Cladocera* | 167[a] | 121[bc] | 102[e] | 129[b] | 117[cd] | 100[e] | 9.97 |
| *Copepoda* | 114[a] | 87[c] | 64[e] | 92[cb] | 73[ed] | 60[ef] | 8.24 |

In ponds No. 1 & 4 only males were cultured.
In ponds No. 2 & 5 males were cultured together with females and about 80% of their fry were removed during the growing season.
In ponds No. 3 & 6 males were cultured together the females and their fry were not removed during the growing season.
SE = The standard error (calculated from the residual mean).
a,b,... etc. means in same raw with different superscriptss are different ($p \leq 0.05$).

Table (10): The effect of fertilization regardless the culture type and vice versa on the average number of Phyto-zooplankton in gut of tilapia *(Oreochromis niloticus)* reared in earthen ponds.

| Items | Treatments | | | | | | |
|---|---|---|---|---|---|---|---|
| | Effect of fertilization irrespective of the culture type | | | Effect of the culture type irrespective of the fertilization | | | |
| | Fertilized ponds | Unfertilized ponds | ± SE | Only Males | Males+Females (80% fry were removed) | Males+Females (their fry not removed) | ± SE |
| Phytoplankton:- | | | | | | | |
| *Chrysophyta* | 716.00[a] | 516.33[b] | 99.84 | 735.00[a] | 640.00[b] | 473.50[c] | 76.42 |
| *Chlorophyta* | 1980.00[a] | 1545.33 | 217.34 | 1994.50[a] | 1721.50[b] | 1572.00[c] | 123.69 |
| *Cyanophyta* | 325.67[a] | 226.30[b] | 49.69 | 339.00[a] | 267.00[b] | 222.00[c] | 34.07 |
| Zooplankton:- | | | | | | | |
| *Cilliata* | 265.33[a] | 199.67[b] | 32.83 | 280.00[a] | 242.50[b] | 175.00[c] | 30.72 |
| *Rotifera* | 229.00[a] | 195.00[b] | 17.00 | 265.00[a] | 197.50[b] | 173.50[c] | 27.39 |
| *Cladocera* | 1320.00[a] | 115.33[b] | 7.34 | 148.00[a] | 119.00[b] | 101.00[c] | 13.69 |
| *Copepoda* | 88.33[a] | 75.00[b] | 6.67 | 103.00[a] | 80.00[b] | 62.00[c] | 11.86 |

SE = The standard error (calculated from the residual mean).
a,b,... etc. means in same raw with different superscriptss are different ($p \leq 0.05$).

programme used in the present study was more efficient than that used by Schroder et al., (1990).

As shown in tables (7&8), protein efficiency ratio (PER), protein productive value (PPV) and net protein utilization (NPU) values were higher in fertilized pond than that found in unfertilized ones. The data revealed that the protein utilization ylaues were higher in all male tilapia than the other treatments because males spend protein, energy and metabolic reseves in growing rather than reprodution.

The quantities of phyto-zooplankton in gut of fish (frequency occurrence "FO" and percentage occurrence "PO") are shown in tables (9,10,1112,13 and 14). It is worthy to note that the advantages of (FO) and (PO) methods are that provided food items are readily identifiable, it is a quick method and requires simple apparatus and give indication of the relative amount or bulk of each food category present in the stomach. These values were higher in fertilized ponds than that unfertilized ponds. Johnson, (1977) has used these methobs as an indicator of interspecific competition by assuming that there the occurrence of a food item exceeded 25.0% in two or more predators competition was likely. The present data showed higher (PC) vlaue than 25.0% and cleared that the Nile tilapia are both animal and plant planktonic. The literature dealing with the feed habits of tilapia (*Oreochromis niloticus*) and discussed the diversity in the opinious of the various authors. Mc Bay (1961) reported that tilapia (*O. niloticus*) is a consumer of benthic Tendipedidae and Ceratopogonidae. However, Moriarty (1973) pointed out to the ability of this species to digest blue green algae, while Spataru (1982) stated that (*O. niloticus*) feeds on diatoms, on protozoa and on invertebrate. Bowen (1982) stated that the characteristic diet of adult tilapia is plant matter and/or detritus of plant origin. He added that the Blue-green algae, Diatoms, macrophytes and amorphous detritus are all common constituents of adult tilapia diets. According to Hepher (1988), tilapias (*O. niloticus*) feeds on epiphytic diatoms and benthic algae. Recently, Sweilum (1995) stated that the plant organisms recorded in the alimentary canals of tilapia (*O. niloticus*) recieved artificial food were chrysophyta *(Navicula sp. Cyclotella sp. and Melosira sp.),* Chlorophyta *(pediasturn sp., Scenedesmus sp., Staurostum sp., Spyrogyra sp., and Englinomorpha sp).* and Cyanophyta *(Merismopedia sp. and Nostoc sp.)* While, the animal organisms include, Cilliophora *(Cilliata sp.)*, Rotifera *(Brachionus sp.)* Cladocera *(Daphnia sp.)* Copepods *(Cyclops sp.)* Chironomidae *(Chironomid larvae)* and Oligochaeta (tubifex worm). In addition to the plant and animal organisms, the artificial food was also represented in the guts of fish with suitable quantities of detrital materials. However, such diversity in the opinion of various authors stem first and foremost from the different conditions.

Table (11): Frequency Occurrence (FO) of Phyto-zoopto-zooplankton in gut of tilapia (*Oreochromis niloticus*) reared in earthen ponds.

| Items | Treatments | | | | | | ±SE |
|---|---|---|---|---|---|---|---|
| | Fertilized ponds | | | Unfertilized ponds | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | |
| Phytoplankton:- | | | | | | | |
| *Chrysophyta* | 79.11$^{a}$ | 63.25$^{b}$ | 50.00$^{d}$ | 60.19$^{bc}$ | 51.23$^{de}$ | 42.72$^{f}$ | 5.23 |
| *Chlorophyta* | 65.33$^{a}$ | 56.42$^{bc}$ | 50.82$^{c}$ | 58.44$^{b}$ | 52.67$^{d}$ | 46.11$^{ef}$ | 2.72 |
| *Cyanophyta* | 51.27$^{a}$ | 42.33$^{bc}$ | 37.17$^{d}$ | 43.71$^{b}$ | 36.20$^{de}$ | 29.00$^{e}$ | 3.11 |
| Zooplankton:- | | | | | | | |
| *Cilliata* | 92.00$^{a}$ | 84.00$^{c}$ | 79.00$^{de}$ | 88.00$^{b}$ | 82.00$^{cd}$ | 77.00$^{e}$ | 2.29 |
| *Rotifera* | 76.00$^{a}$ | 66.00$^{c}$ | 58.00$^{e}$ | 69.00$^{b}$ | 62.00$^{d}$ | 55.00$^{ef}$ | 3.13 |
| *Cladocera* | 84.00$^{a}$ | 78.00$^{b}$ | 75.00$^{bc}$ | 73.00$^{cd}$ | 64.00$^{e}$ | 53.00$^{f}$ | 4.51 |
| *Copepoda* | 73.00$^{a}$ | 64.00$^{b}$ | 60.00$^{c}$ | 57.00$^{cd}$ | 50.00$^{e}$ | 43.00$^{f}$ | 4.70 |

In ponds No. 1 & 4 only males were cultured.
In ponds No. 2 & 5 males were cultured together with females and about 80% of their fry were removed during the growing season.
In ponds No. 3 & 6 males were cultured together the females and their fry were not removed during the growing season.
SE = The standard error (calculated from the residual mean).
a,b,... etc. means in same raw with different superscriptss are different ($p \leq 0.05$).

Table (12): The effect of fertilization regardless the culture type and vice versa on frequency occurrence of Phyto-zooplankton in gut of tilapia (*Oreochromis niloticus*) reared in earthen ponds.

| Items | Treatments | | | | | | |
|---|---|---|---|---|---|---|---|
| | Effect of fertilization irrespective of the culture type | | | Effect of the culture type irrespective of the fertilization | | | |
| | Fertilized ponds | Unfertilized ponds | ± SE | Only Males | Males+Females (80% fry were removed) | Males+Females (their fry not removed) | ± SE |
| Phytoplankton:- | | | | | | | |
| *Chrysophyta* | 64.12$^{a}$ | 51.38$^{b}$ | 6.37 | 69.65$^{a}$ | 57.24$^{b}$ | 46.36$^{c}$ | 6.73 |
| *Chlorophyta* | 57.52$^{a}$ | 52.41$^{b}$ | 2.56 | 61.89$^{a}$ | 54.55$^{b}$ | 48.47$^{c}$ | 3.88 |
| *Cyanophyta* | 43.59$^{a}$ | 36.30$^{b}$ | 3.65 | 47.49$^{a}$ | 39.27$^{b}$ | 33.09$^{c}$ | 4.17 |
| Zooplankton:- | | | | | | | |
| *Cilliata* | 85.00$^{a}$ | 82.33$^{b}$ | 1.34 | 90.00$^{a}$ | 83.00$^{b}$ | 78.00$^{c}$ | 3.48 |
| *Rotifera* | 66.67$^{a}$ | 62.00$^{b}$ | 2.34 | 72.50$^{a}$ | 64.00$^{b}$ | 56.50$^{c}$ | 4.62 |
| *Cladocera* | 79.00$^{a}$ | 63.30$^{b}$ | 7.85 | 78.50$^{a}$ | 71.00$^{b}$ | 64.00$^{c}$ | 4.19 |
| *Copepoda* | 65.67$^{a}$ | 50.00$^{b}$ | 7.84 | 65.00$^{a}$ | 57.00$^{b}$ | 51.50$^{c}$ | 3.92 |

SE = The standard error (calculated from the residual mean).
a,b,... etc. means in same raw with different superscriptss are different ($p \leq 0.05$).

Table (13): Percentage composition (PC) of Phyto-zoopto-zooplankton in gut of tilapia (*Oreochromis niloticus*) reared in earthen ponds.

| Items | Treatments | | | | | | ±SE |
|---|---|---|---|---|---|---|---|
| | Fertilized ponds | | | Unfertilized ponds | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | |
| Phytoplankton:- | | | | | | | |
| *Chrysophyta* | 22.49$^{a}$ | 18.34$^{c}$ | 15.99$^{e}$ | 19.00$^{c}$ | 17.17$^{cd}$ | 14.66$^{f}$ | 1.1 |
| *Chlorophyta* | 41.93$^{a}$ | 37.64$^{bc}$ | 34.00$^{d}$ | 39.20$^{b}$ | 31.11$^{e}$ | 28.34$^{f}$ | 2.11 |
| *Cyanophyta* | 9.27$^{a}$ | 8.00$^{b}$ | 7.54$^{bc}$ | 7.33$^{c}$ | 5.68$^{d}$ | 4.26$^{e}$ | 9.73 |
| Zooplankton:- | | | | | | | |
| *Cilliata* | 15.33$^{a}$ | 13.97$^{c}$ | 12.77$^{d}$ | 14.00$^{b}$ | 13.31$^{e}$ | 12.66$^{f}$ | 0.40 |
| *Rotifera* | 9.730$^{a}$ | 8.44$^{b}$ | 7.41$^{c}$ | 8.21$^{b}$ | 7.00$^{c}$ | 6.12$^{e}$ | 0.51 |
| *Cladocera* | 4.88$^{a}$ | 6.75$^{b}$ | 5.66$^{c}$ | 6.68$^{b}$ | 5.30$^{c}$ | 4.25$^{d}$ | 0.52 |
| *Copepoda* | 6.51$^{a}$ | 5.23$^{b}$ | 4.12$^{c}$ | 5.89$^{b}$ | 4.53$^{c}$ | 3.49$^{d}$ | 0.46 |

In ponds No. 1 & 4 only males were cultured.
In ponds No. 2 & 5 males were cultured together with females and about 80% of their fry were removed during the growing season.
In ponds No. 3 & 6 males were cultured together the females and their fry were not removed during the growing season.
SE = The standard error (calculated from the residual mean).
a,b,... etc. means in same raw with different superscriptss are different ($p \leq 0.05$).

Table (14): The effect of fertilization regardless the culture type and vice versa on percentage composition of Phyto-zooplankton in gut of tilapia (*Oreochromis niloticus*) reared in earthen ponds.

| Items | Treatments | | | | | | |
|---|---|---|---|---|---|---|---|
| | Effect of fertilization irrespective of the culture type | | | Effect of the culture type irrespective of the fertilization | | | |
| | Fertilized ponds | Unfertilized ponds | ± SE | Only Males | Males+Females (80% fry were removed) | Males+Females (their fry not removed) | ± SE |
| Phytoplankton:- | | | | | | | |
| *Chrysophyta* | 18.94$^{a}$ | 16.94$^{b}$ | 1.00 | 20.75$^{a}$ | 17.76$^{b}$ | 15.31$^{c}$ | 1.57 |
| *Chlorophyta* | 37.86$^{a}$ | 32.88$^{b}$ | 2.49 | 40.57$^{a}$ | 34.38$^{b}$ | 31.17$^{c}$ | 2.76 |
| *Cyanophyta* | 8.27$^{a}$ | 5.76$^{b}$ | 1.26 | 8.30$^{a}$ | 6.84$^{b}$ | 5.90$^{c}$ | 0.70 |
| Zooplankton:- | | | | | | | |
| *Cilliata* | 14.02$^{a}$ | 13.32$^{b}$ | 0.35 | 14.67$^{a}$ | 13.64$^{b}$ | 12.72$^{c}$ | 0.56 |
| *Rotifera* | 8.53$^{a}$ | 7.11$^{b}$ | 0.71 | 8..97$^{a}$ | 7.72$^{b}$ | 6.77$^{c}$ | 0.64 |
| *Cladocera* | 6.76$^{a}$ | 5.41$^{b}$ | 0.68 | 7.28$^{a}$ | 6.03$^{b}$ | 4.96$^{c}$ | 0.67 |
| *Copepoda* | 5.29$^{a}$ | 4.64$^{b}$ | 0.33 | 6.20$^{a}$ | 4.88$^{b}$ | 3.81$^{c}$ | 0.69 |

SE = The standard error (calculated from the residual mean).
a,b,... etc. means in same raw with different superscriptss are different ($p \leq 0.05$).

**2- Culture of males together with females and about 80% from their fry were removed during the growing season:**

The average performance is shown in tales (4,5 and 6). The resutls showed that the highest growth rate was occured in fertilized ponds, but, this value was less than that found in all male culture case.

As shown in tables (7 & 8), the (PER), (PPV) and (NPU) values were higher in fertilized ponds than that found in unfertilized ponds. The data cleared that these values were higher than that obtained by Shehata and Shehata (1994) because they left tilapia's fry in ponds along the growing season and they didn't use fertilizers. In the present work, these values were increased in fertilized ponds because there was no feed competition found between adult fish and their fry related to abundance and type of food available to fry.

As shown in tables (9,10,11,12,13 and 14), the (FO) and (PO) values were higher in fertilized ponds than that found in unfertilized ones. Also, the (FO) and (PC) values in the present state were hgiher than that determined by Sweilum (1995) because he left tilapia's fry in the ponds during the growing season and he didn't use the fertilizers. These data cleared that there is a good relation between primary production and removing of fry. The phyto-zooplankton abundance and composition have been measured more frequently in this system and they were clearly affected both by fertilization and removing of fry.

**3- Culture of males together with females and their fry were not removed during the growing seaon:**

The average performance results are shown in tables (4,5 and 6). The results showed that the highest growth rate was occured in fertilized ponds, but, this value was less than that found in other treatments.

As shown in tables (7 and 8), the (PER), (PPV) and (NPU) values were higher in fertilized ponds than that found in unfertilized ponds. These values were lower than that occured in fry free ponds. As shown in tables (9, 10, 11, 12, 13 and 14), in gut of fish, the (FO) and (PC) values were much higher than that found in gut of fish reared in unfertiliged ponds. While, these values were lower than that found in gut of fish reared in fry free ponds. It means that the fry consumed large food batch. Fry normally consume 40-80 percent of the their body weight daily, assimilating from 89-98 percent of ingested food, (Eugene, 1986). Practically, every aquatic animal, vegetable and mineral small enough to pass through the esophagus has been found in the guts of fry (Bowen, 1982). Some of this variety must be attributed to items that are occusionally abundant in the diet but are rare or absent most of the time. Thus, the chemical fertilizers are very necessary for their importance in enhancing pond production by sparing the abundance and type of food available to fry. In common, with early developmeintal stages of nearly all fishes, the larvae, fry and early Juvenile tilapias feed on small invertebrates, especially crustacea (Bowen, 1982). The transition from an invertebrate diet to the typical adult diet is usually abrupt (Moriarty et al., 1973) but in some cases it may occur gradually in the period of a year or more. In such systems where large numbers of fry are reared, the importance of zooplankton as a first food for larvae and fry of tilapia *(O. niloticus)* is well recognized. Zooplandkton are high in protein and essential amino acids are easily digested. since larvae and fry need food items that are visible, suspended in the water, small enough to be ingested, nutritions and palatable so that larvae and fry of most fishes feed initially on zooplankton. Although smaller phytoplankton and large zooplankton may be important first food for some species, rotifers, copepod nauplii and copepodites, protozoa and small cladocera in the 50-200µ range are the predominant first foods of most species. The relative digestion rates of fry may result in erroneous extimates of food selectivity due to the more rapid disappearance of certain species from the gut, (e.g., Cladocera are digested much more rapidly than Copepods).

Although many basic interactions between fish larvae and/or fry and available preferred phyto-zooplankton to the adult fish in earthen ponds. To correct this situation, culture of all male tilapia should be conducted. When techniques of all male tilapia pond management can't be "fine tuned" to greatly increase fish yield, the chemical fertilizers with optimum doses should be used, because it is largely related to the abundance and type of food available to fry to avoid feed competition.

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