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EFFECT OF METHOD AND RATES OF FEEDING ON THE GROWTH PERFORMANCE AND FEED UTILIZATION OF MONOSEX TILAPIA NILOTICA (*Oreochromis niloticus* L.) IN SEMI-INTENSIVE CULTURE SYSTEM

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ABSTRACT

This study was carried out to investigate the effect of method and rates of feeding on growth performance, feed utilization and econmic evaluation for *Oreochromis niloticus* L. reared in aerated earthen ponds. Nine rectangular earthen ponds, each of a total area of one feddan, representing nine treatments,i.e. three different methods of feeding (hand feeding, automatic feeder and demand feeder) within each of three feeding rates (3, 4 and 5 % of total biomass of fish)were tested . Experimental fish were fed on a commercial diet (25% CP and 4100 Kcal / kg diet) and ponds were fertilized with 100 kg organic fertilizer (chicken manure , devided into two portions) monthly . One paddle wheel aerator (1 horse power) per pond was used to increase the rate of oxygenation of pond water . The pond water was completly changed every 30days. The experiment expanded 16 weeks after start .

Results obtained can be summarized as follows :

The water quality measurements were found to be within the normal range of tolerance and for the well being of monosex Nile tilapia.

Results obtained at the end of the experiment for the growth performance of monosex Nile tilapia represented in body weight (BW), weight gain (WG), accumulative growth rate(AGR), total yield (TY) ,feed intake (FI), and feed conversion ratio (FCR) showed that fish fed by automatic feeder at 5% feeding rate of tilapia biomass / day exhibited superior growth performance rather than those reared on demand feeder and hand feeding at 3% and 4% of tilapia biomass/ day. Statistical evalation of the results showed that the differences among the experimental groups were significant ($p < 0.05$) .

Based on the results obtained, it could be recommended that using the automatic feeder method with 5% of biomass/ day as a feeding rate for monosex Nile tilapia cultured in earthen ponds at stocking density of 50 fish/m^3 with using a paddle wheel aerator per pond must be used to increase the rate of oxygenation of pond water to obtain higher yield and economic net profit .

Keywords: Method of feeding , Rates of feeding , Monosex *Tilapia nilotica*, Growth, FCR ,Proximate analysis and Economic evaluation .

INTRODUCTION

The main problem in the culturc of tilapias is their proliferation. They breed easily at an early age (3-6 months) even when they are still small, and they have multiple spawning during the year. This can increase the fish population in ponds to such an extent that stunting growth occurs, and also spend a lot of energy effort in nursing and protecting their progenies until they are big enough to swim and feed on their own (Mires, 1995). To overcome this problem it is necessary either to use species that grow fast and reach marketable size befcr they breed, or to breed monosex population (Hepher and Prugining, 1981).

Information about temporal variations in fish food intake is required for optimal feed utilization . This information also might help in the design of feeding regimes for fish in aquaculture. Supplemental feeding constitutes about 40-70% of the total fish production cost (N R C , 1983and FAO,1984).Determining the optimum pattern of feed added to fish ponds is one of the most important tasks in pond management . Therefore, some concern should paid to reduce this expense by feeding the correct amount at the right time to insure maximum efficiency . Mean while , realization of the optimum feeding regime for cultured fish would help to reduce feed wastes and costs and maximizing feed conversion efficiency (Charles *et al*, 1984;Sampath, 1984 ; Chiu *et al*, 1987and Diana ; 1997) . Feeding frequency was shown to have a significant ($p < 0.05$) effect on food consumption and growth. Fish fed to apparent satiation in two or four daily meals consuming more food and grow better than fish fed less (often once daily and two meals every other day) (Dwyer *et al.* , 2002).

The aim of this study was to investigate the optimum feeding methods by using three different feeding rates on the growth performance , feed utilization, and economic evaluation of monosex Tilapia nilotica *(Oreochromis niloticus)* reared in earthen ponds in semi–intensive culture system .

MATERIALS AND METHODS

This study was conducted at the graduated village in khashaa belonging to kafer EL-Sheikh Governorate . Nine earthen ponds, one feedan area each, with an average water depth of 1.25m were used in this study. All ponds were stocked with(21000 fish / feddan) fingerlings of monosex Nile tilapia (*Oreochromis niloticus*) obtained from a local hatchery in kafer EL-Sheikh (fish were treated by 17 α ˙ methyl testesterone for 28 days) at a rate of 50 fish / m^3 water with an average initial body weight of 12.51 g / fish. One paddle wheel aerator (1 horse power) per pond was used to increase the rate of oxygenation of pond water. The experiment lasted for 4 months starting on June ,st and continued to 30th September 2002. Monthly fish samples were taken at random from each pond, and the amount of feed added was accordingly readjusted. The ponds were assigned to one of the following nine treatments : T_1 (3% feeding rate with hand feeding) ,T_2(3% feeding rate with automatic feeder) , T_3(3% feeding rate with demand feeder) , T_4 (4% feeding rate with hand feeding) , T_5 (4% feeding rate with automtic feeder) T_6(4% feeding rate with demand feeder) , T_7(5% feeding rate with hand feeding) , T_8 ((5% feeding rate with automatic feeder) and T_9 (5% feeding rate with demand feeder) . Fish were fed on a commercial diet (25% CP and 4100 kcal / kg diet)and fertilized with organic fertilizaters (chicken manure) at a rate of 100kg / feddan / month . Fish were fed the diet with automatic feeder at 9.00 , 11.00, 13.00 , 15.00 and 17.00 hr. On the other hand, the hand feeding was conducted twice daily at 9.00 and 12.00 hr. water was completly changed every 30 days ,this water came from agriculture reservoir canal as a fresh water source .

The chemical composition of the diet used was 91.6% dry matter, 24.9% crude protein, 10.9% crude fat, 4.9% crude fiber and 9.4% ash, while

that of chicken manure was 91.1% dry matter, 18.9% crude protein, 2.9% crude fat, 32% ash, 12% crude fiber, nitroger 1.7, potassium 1.0 and phosphorus 2.0%. This commercial diet was 2 mm (pelleted) size ,obtained from Zo. Control Company in 6 October City, while chicken manure from battery without letter was obtained from El-Ahlia for Chicken Company. .

Water samples were biwekly collected from fish ponds after three days of the fertilization and offering the pelleted rations. Water samples were taken from each corner of the pond , using a bottle sampler and mixed together to be ready for analysis. Water temperature and oxygen content were measured daily by oxygenmeter model YSI 57.The pH value was measurd weekly by an electrode pH meter. The concentrations of ammonia, total alkalinity, total hardness, nitrate, nitrite, salinity and orthophosphate were determined according to Boyd (1981). The water visibility and turbidity were determind using Secchi disk to predict the availability of natural food in ponds .

The economic efficiency for fish production was calculated , based on the differences between the cost of feed , labor work , cost of fingerlings , fertilizer and the price of the fish production according to the market price at the time of harvesting .

Completely randomized design for the statistical analysis of variance was applied on the collected data according to. SAS program (1987). Differences between means were tested for significance according to Duncan (1955) .

RESULTS AND DISCUSSION

Water quality:

Water quality parameters are shown in Table (1) . The averages of temperature ranged from 26.5 to 28°c during the experimental period . In general, water temperature was adequate for tilapia growth during the experimental period .The allover mean temperature for all treatments during the experiment was 26.63 °c .This temperature is suitable for all chemical, physical , and biological processes in ponds water as cited by Boyd (1979). Warm water species which are native to temperate climates and best semitropical conditions, grow at temperatures ranged between 20 and 28 °C as stated by Boyd (1990). The overall average of Secchi disk reading was slightly lower for the T8 treatments (16 cm) compared to the other treatments. The range of Secchi disk visibility was 16-28 cm for all experimental ponds and was within the accebtable limits (Boyd, 1979). Water quality parameters of fish ponds were in a good conditions as Secchi disk visibility was between 30- 45cm, when turbidity in form of phytoplankton (Boyd , 1990).

Field observation during early morning revealed that dissolved oxygen (DO) was closely related to the growth and survival of tilapia fish. The averages of DO concentration ranged between 6.9 and 8.8 mg/l. The previous results agree with NACA (1989) recommendations .

Semi-intensive culture system is characterized by high stocking and requires relatively more dissolved oxygen coucentration in water bodies (Anand and Mukherjee, 2000) .In this connection, aerators are used to increase the rate of oxygenation in pond water . paddle wheel aerator is a type of surface aerator in which the shaft is fitted horizontally and the paddle

(blades) partially submerged in water , more in the vertical plane at low speed and generate the turbulence and splashing of water . Any type of aerator can be used for emergency aeration , but paddle wheel aerators driven by the power – take off (PTO) of farm tractors are probably the most effective (Boyd and Tucker, 1997). Besides aeration , paddle wheel serves in proper mixing of the recharged water in aquacuhure ponds and improving the water quality and unifrom distribution of feed vertically and horizontally in water body and helping goremain suspending in water .

Table (1): Mean values of different water physico-chemical parameters in the experimental earthen ponds .

Parameters	Treatments								
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9
Temperature(°c)	27	27	27	26.5	27	26.5	27	28	26
Secchi disk (cm)	28	25	25	20	17	18	19	16	17
Dissolved O_2 (mg/l)	8.8	8.3	8.6	8.7	8.2	8.5	7.2	6.9	7.0
PH value	7.0	7.3	7.1	7.0	7.4	7.2	7.0	7.5	7.2
Ammonia (mg/l)	0.11	0.12	0.12	0.11	0.12	0.11	0.11	0.14	0.13
Total alkalinity(mg/l)	302	310	307	310	316	313	312	319	314
Total hardness(mg/l)	230	250	240	250	260	255	275	280	278
NO_2 (mg/l)	0.01	0.02	0.01	0.01	0.02	0.02	0.01	0.02	0.02
NO_3 (mg/l)	0.10	0.12	0.11	0.12	0.15	0.12	0.12	0.17	0.14
Salinity (g/l)	0.1	0.2	0.1	0.1	0.2	0.2	0.1	0.1	0.2
O.P (mg/l)	0.13	0.15	0.14	0.15	0.22	0.18	0.25	0.44	0.36

Means with the letter in the same row not significantly different at ($p > 0.05$).

The average values of pH ranged from 7 to 7.5 in all treatments . the value of pH was higher in T_6 than the other treatments . Generally, the pH levels were suitable for well being of tilapia fish . In this respect , Boyd and Lichkpoppler (1979) demonstrated that water with pH values of about 6.5 to degrees daybreak is considered the best for fish production.

Total alkalinity ranged from 302 mg /l in $T_1$to 319 mg/ l in T_9 . However in T_8 pond, water alkalinity was higher (319 mg/l) compared with all other treatments. This may be due to alkaline pond soils . On the other hand, the total hardness ranged from 230 to 280 mg/l. Boyd (1981) reported that as long as the hardness values of pond water are over 200 mg/ l no deleterious effects would be seen . Hence, it is evident that in most water types hardness levels will be adequate for fish . On the other hand , nitrate did not exceed 0.17 mg/ l in different treatment. Generally, none of the values mentioned in Table 1was found to be outside the normal ranges of tolerance for Nile tilapia growth according to Abdelhamid (2003) .

Fish growth performance :

The average of initial live body weight (LBW) of monosex *Tilapia nilotic*a for all treatment were 11.7 – 12.3 g without significant differences between all treatments . The results of fish growth showed that all treatments of fish gave satisfactory growth during the experimental period, since LBW values increased progresively with age advancement. Highest average LBW was observed for T_8 (218.69g / fish)at the end of the experiment .T_8 surpassed all other treatments during the progress of the experimental period,

followed by T_9 and T_5 while T_1 exhibited the lowest L B W value (155.90 g /fish).The differences in final weight among the nine treatments were found to be significant ($p < 0.05$, Table 2) .

Table (2): Averages of live weight (g/fish)of monosex Tilapia nilotica during different rearing periods In the experimental earthen ponds

Treatments	Fish growth (g/fish)				
	Fish wt. at initial	Fish wt. after 30 day	Fish wt . after 60 day	Fish wt. after 90 day	Fish wt . after 120 day
T_1	12.3± 0.76 a	35.89±0.75e	69.67±0.81g	108.63±0.79h	155.90±1.17 i
T_2	12.0±0.78 a	37.63±0.85d	78.51±0.91e	124.26±0.94e	180.0±1.10 e
T_3	12.1±0.76a	35.49±0.74e	70.36±0.93g	111.23±0.91g	161.89±1.34h
T_4	11.8±0.77a	35.44±0.77e	70.90±0.79g	111.17±0.80g	165.79±0.95g
T_5	12.0±0.75a	38.51±0.87d	82.90±0.95d	131.33±1.08d	189.99±1.27c
T_6	11.7±0.74 a	36.03±0.81e	76.12±0.96f	121.28±1.01f	177.0±1.56f
T_7	12.3±0.76a	43.4±0.93c	88.27±1.10c	134.43±1.19c	186.69±1.53d
T_8	12.2±0.78a	48.07+1.12a	97.78±13.4a	156.69±1.44a	218.69±1.73a
T_9	11.8±0.79a	45.69±1.12b	91.15±2.27b	144.58±1.32b	201.60±1.53b

Means with the same letter in the same column are not significantly different at ($p > 0.05$) .

Results in Table (3) showed the averages of body weight gain (BWG) of tilapia fish during the experimental periods . It is obvious that the average weight gain of T_8 and T_9 surpassed all the other treatments during the progresive time of the whole experimental period . Meanwhile, T_1(that used 3% feeding rate with hand feeding) gave lower body weight gain values . On the other hand , a similar trend for the accumulated growth rate(g / d) was reported (Table 4) .

Table (3): Fish weight gain (g/fish) of monosex Tilapia nilotica at different rearing periods in the experimental earthen ponds .

Treatments	Fish wt. gain (g/fish)			
	0-30 days	30- 60 days	60-90 days	90-120 days
T_1	23.59±0.01e	33.78±0.01d	38.96±0.01e	47.27±0.02e
T_2	25.63±0.01d	40.88±0.01c	45.75±0.01d	55.74±0.03c
T_3	23.39±0.01e	34.87±0.01d	40.87±0.01e	50.66±0.01d
T_4	23.64±0.01e	35.46±0.03d	40.27±0.01e	54.62±0.01c
T_5	26.51±0.01d	44.39±0.06b	48.43±0.01c	58.66±0.02b
T_6	24.33±0.01e	40.18±0.01c	45.07±0.01d	55.72±0.03c
T_7	31.1±0.01c	44.87±0.02b	46.16±0.01d	52.26±0.02d
T_8	36.87±0.01a	49.71±0.01a	58.91±0.01a	62.00±0.02a
T_9	33.89±0.01b	45.46±0.01b	53.43±0.01b	57.02±0.02b

Means with the same letter within the same column are not significantly different at ($p>0.05$).

These results are in partial agreement with the findings of Hashish *et al.* (1997) who found that the best treatment for aquaculture fishes (polyculture) is dry feeding (automatic demand feeder) and liquid fertilization (up and subsurface outlet of water in the pond system) under

aeration system of center four tube, and the best treatment of aquaculture fishes (tilapia monoculture) is dry feeding (automatic demand feeder) and liquid fertilization (up surface of water in the pond system) under aeration system of center four tube. In this connection, Radwan (1997) found that the best fish growth rate was obtained with the dry feeding by using the automatic demand feeder system. Clark *et al.*, (1990) showed that dietary protein level of 20% supported the growth of red tilapia from 10.2 to 44.0 g. These results are in accordance to the findings of Pillary (1990) who tested different types of automatic feeders are used for prepared feeds in larval tanks and grow out areas . He found that electrically activated timing devices make it possible to dispense set amounts of feed at given intervals .

Table (4): Accumulative growth rates (g/day) of monosex Tilapia nilotica during different rearing periods in the experimental earthen ponds .

Treatments	Fish growth rates (g/day)			
	0-30 days	30- 60 days	60-90 days	90-120 days
T_1	1.92±0.49b	4.66±0.23bc	7.83±0.22c	11.67±25c
T_2	2.13±0.48a	5.54±0.33b	9.35±0.12b	14.0±0.27b
T_3	1.93±0.46b	4.81±0.24bc	8.19±0.23c	12.38±0.23c
T_4	2.00±0.44a	5.01±0.33b	8.42±0.12c	13.05±0.29c
T_5	2.21±0.47a	5.91±0.33b	9.94±0.13b	14.83±0.27b
T_6	2.08±0.45a	5.51±0.24b	9.36±0.24b	14.13±0.24b
T_7	2.53±0.47a	6.18±0.33a	9.93±0.13b	14.18±0.28b
T_8	2.94±0.51a	7.01±0.35a	11.84±0.12a	16.92±0.28a
T_9	2.87±0.49a	6.72±0.33a	11.52±.12a	16.08±0.27a

Means with the same letter in the same column are not significantly different at (p > 0.05).

Feed utilization :

Averages of total BWG , feed intake and feed conversion ratio during the whole experimental period, i.e 120 days are presented in Table (5). Results of this table show that the FI showed that fish fed on T_8 (5% feeding rate with automatic feeder) and T_9 (5% feeding rate with demand feeder) consumed more feed than the other treatments . However, results of Table (5) showe that feed intake in T_1 (3% feeding rate with hand feeding) revealed the lowest value (203.84g feed/ fish) .

From the results of table (5) , T_2 (3% feeding rate with automatic feeder) showed better FCR(1.35)than the other treatments, while T_7(5% feeding rate with hand feeding) showed highest value (2.39). These results agree with the findings of NACA (1989) who showed that feed conversion ratio is affected by many factors, particularly management of ponds . An improvement in management level can improve the conversion ratio, i.e. the same amount of feed that could result in higher fish yield . Results are in accordance with those obtained by Hargreaves *et al* . (1988) who observed lower mean feed conversion ratios of fish obtaining feed demand feeders than for fish fed according to a fixed regime .

Table (5): Average of growth performance parmeters ,feed intake (FI) and feed conversion ratio (FCR) of monosex Nile tilapia as effected with the applied treatments .

Treatments	Different parameters				
	Initial fish wt. (g/fish)	Final fish wt. (g/fish)	Weght gain (g/fish)	Feed intake (g feed /fish)	FCR
T_1	12.3±0.76 a	155.90±1.17 i	143.6±0.01i	203.84±3.50h	1.42±0.30c
T_2	12.0±0.78 a	180.0±1.10 e	168.0±0.01e	227.15±4.00g	1.35±0.35c
T_3	12.1±0.76a	161.89±1.34h	149.79±0.01h	206.26±4.02h	1.37±0.38c
T_4	11.8±0.77a	165.79±0.95g	153.99±0.01g	275.16±4.30f	1.78±0.02b
T_5	12.0±0.75a	189.99±1.27c	177.99±0.02c	317.69±5.35d	1.78±0.03b
T_6	11.7±0.74 a	177.00±1.56f	165.30±0.01f	294.26±4.46e	1.78±0.03b
T_7	12.3±0.76a	186.69±1.53d	174.39±0.01d	417.59±6.01c	2.39±0.08a
T_8	12.2±0.78a	218.69±1.73a	206.49±0.01a	472.10±7.40a	2.28±0.06a
T_9	11.8±0.79a	201.60±1..53b	189.8±0.01b	439.82±6.62b	2.32±0.07a

Means with the same letter in the same column are not significantly different at (p > 0.05) .

Chemical composition of fish :

The proximate chemical composition of fish whole body at different treatments at the end of the experimental period is shown in Table (6) . The average of moisture content in all treatments ranged from 74.9% to 76.5% . Average values of crude protein content in fish bodies in all treatments ranged from 57.7% to 63.2%. Similarly, mean values of ether extract ranged from 14.8% to 26% .

Table (6): Chemical composition of whole body of monosex Nile tilapia (% on dry matter basis) reared in the experimental earthen ponds .

Treatments	Moisture	Crude protein	Ether extract	*Ash*
At the initial				
	81.33±0.214	71.64±0.312	14.06±0.010	*14.30±0.010*
At the end				
T_1	75.50±0.37a	63.20±1.90a	14.80±1.80e	22.00±1.65a
T_2	75.00±0.49a	59.69±1.42bc	20.49±1.32d	19.82±1.54b
T_3	76.50±0.45a	61.80±1.90a	15.40±1.30a	22.80±1.50a
T_4	75.37±0.37a	60.90±1.96ab	17.40±1.91d	21.70±1.68a
T_5	75.50±0.59a	58.00±1.39c	24.45±2.06a	17.55±1.90c
T_6	74.90±0.55a	60.00±1.35abc	19.30±2.0c	20.70±1.80a
T_7	75.50±0.68a	59.30±1.59bc	21.79±1.68b	18.91±0.74bc
T_8	75.50±0.95a	57.70±1.04c	26.00±1.69a	16.30±0.81d
T_9	*75.60±0.73a*	*57.90±1.61c*	*25.72±3.90a*	16.38±2.71cd

Means with the same letter in the same column are not significantly different at p > 0.05

The average values of ash content in fish bodies in all treatments ranged from 16.30% to 22.80%. Analysis of variance among the experimental treatments were significant ($p < 0.05$). These results indicate

that, T_8 (3% feeding rate with automtic feeder) showed higher ($p < 0.05$) fat content, but it caused lower protein and ash contents . There results may indicate that there is a negative correlation between protein or ash content from one side and fat content on the other side . Moisture percent in whole fish was not affected significantly. These results are in accordance with those obtained by Brash and Schroeder (1984). They found that tilapia fat content was higher for fish fed with pellets compared with those raised on fermented cow manure and the differences were significant in this respect (Lovell, 1989) .

Economic efficiency :

Fish harvested were graded into four weight classes, first class = 1-5 fish / kg with a sale price of 8.0 L.E / kg fish , second class = 6-12 fish / kg with a sale price of 6.0 L.E /kg fish, third class = 13-24 fish / kg with a sale price of 4.50 L.E / kg fish and forth class =25-40 fish/ kg with a sale price 3.50L.E / kg fish .

The variable costs of each treatment are grven in Table (7) . Results of this Table indicate that T_1 (3% feeding rate with hand feeding) was the cheapest in cost compered to the other treatments. The obtained results revealed that the total net profit of T_7 was the lowest due to the lower prices of small fish sizes of Nile tilapia than other fish sizes, besides the high total costs. Whereas T_8(5% feeding rate with automatic feeder) showed the highest net profit according to the high final body weight and total income . These results are in partial agreement with those of Wang *et al.* (1985) .

On the other hand , Table (7) indicated that the total fish production ranged from 3.274 ton / feddan at T_1 to 4.592 ton / feddan at T_8 . These production values are much higher compared with fish production of normal semi-intensive fish farming .

Table (7): Variable costs and net profit (Egyptian pound / feddan) in the experimental earthen pounds .

Treatments	Feed costs	Chicken manure costs	Labor & stocking costs	Total costs	Total fish Production (ton / feddan)	Total income	Net profit	Economic efficiency
T_1	5133	100	983	6216	3.274	19643	13427	216.00
T_2	5724	100	983	6807	3.780	22680	15873	233.19
T_3	5198	100	983	6281	3.400	20398	14117	224.76
T_4	6934	100	983	8017	3.482	20889	12872	160.56
T_5	8005	100	983	9088	3.990	23940	14852	163.42
T_6	7415	100	983	8498	3.717	22302	13804	162.44
T_7	10523	100	983	11606	3.920	23522	11916	102.67
T_8	11896	100	983	12979	4.592	36740	23761	183.07
T_9	11083	100	983	12166	4.233	33869	21703	178.39

Net return = Total price of harvest – total cost of production based on the local market in the year (2002) .

Economic efficiency = Net return × 100 / total cost of production .

This can be attributed to the development of pond management throughout high fish stocking, the use of paddle wheel aerators that enhanced the oxygen level and use of 5% feeding rate with automtic feeder. In this respect, Boyd and Watten (1989) reported that the addition of oxygen or air containing oxygen to water is a critical process for fishermen . Also, Boyd *et al* (1986) showed that a 20 % to 25% increase in profit would be a model amount (1.49 kw / h) of supplemental aeration.

Recommendation:

Based on the results obtained, it could be recommended that using the automatic feeder method with 5% of biomass/ day as a feeding rate for monosex Nile tilapia cultured in earthen ponds at stocking density of 50 fish/m^3 with using a paddle wheel aerator per pond to obtain higher yield and economic net profit .

REFERENCES

Abdelhamid, A.M.(2003).Scientific Fundamentals of Fish Production and Husbandry. 2nd Edition .Faculty of Agriculture, Mansoura University, Deposit No. 15733/2003.

Anand, G.and Mukherjee, C.K.(2000) .Engineering design of mini-paddle wheel aerator .The Fifth Indian Fisheries Forum, 17- 20 January , CIFA. Kausalyange, Bhumbaneswar 751002 ,India.

Boyd,C.E.(1979). Water Quality in Warmwater Fish Ponds. Auburn University, Agriculture Experiment Station, Auburn Alabama, pp:359.

Boyd, C. E. (1981). Comparison of five fertilization programs for fish ponds. Trans. Am. Fish Soc., 10: 541-545.

Boyd, C.E. (1990).Water Quality in Warmwater Fish Pond . Auburn. Univ-(Ala) Agr- EXP.Sta .

Boyd, C.E.and Lichkpoppler, F.(1979). Water Quality Management in Pond Fish Culture .Aubura Univ.Exp . St.Res.and Def,. Series No. 22,30pp .

Boyd. C. E. and Tucker, C. S. (1997). Emergency aeration of fish ponds. Amer.Fish. Soc., 108:299-306.

Boyd, C. E. and Watten, B. J. (1989). Aeration system in aquaculture. Rev. Aquatic Sci., pp: 425-472.

Boyd, C. E. ; Rajendren, R. B. and Dura, J. (1986). Economic consideration of fish pond aeration. J. Aquacu. Trop., 1-5.

Brash, H. and Schroeder,G.L. (1984). Use of fermented cow manure as feed substrat for fish polyculture in stayant water pond. Aquaculture, 36: 127-140

Charles, P. M. ; Sebastian, S. M. ; Raj, M. C. and Marian, M. P (1984). Effect of feeding frequency on growth and food conversion of *Cyprinus curpio* fry. Aquacult., 40:293-300.

Chiu, Y. N.; Sumagaysay, N. S. and Sastrillo, M. S. (1987). Effect of feeding frequency and feeding rate on the growth and feed efficiency of milkfish (*Chanos chanos*). Asia. Fish. Scien.,27-30.

Clark, A. E. ; Watanahe. 0.; Olla. B. L. and Wicklund, R. I.(1990).Growth, feed conversion and protein utilization of Florida red tilapia fed isocaloric diets with different protein levels in seawater pools. Aquacult., 88: 77-91.

Diana, J. S. (1997).Feeding strategies- In: Dynamics of Pond Aquaculture, H. S. Egna and C. E. Boyd (eds.). pp: 245-262, CRC Press, Boca Raton, New York, USA.

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

Dwyer, K. S. ; Brown, J. A. ; Pamsh, C. and Lall, S. P. (2002). Feeding frequency, consumption, feeding pattern and growth of juvenile yellowtail flounder (*Limanda ferruginea*). Aquacult., 2: 279-292.

F.A.O. (1984). Inland aquaculture engineering lectures presented at the ADCP Inter-regional training course in inland aquacult. Eng Budapest. 3-6 Sep. pp:569-573 .

Hargreaves, J.A., Rakocy, J.E . and Nair, A. (1988) . An evaluation of fixed and demand feeding regimes for cage culture of *Orcochromis aureus*, the SECMU international symposium on Tilapia in aquaculture. ICLARM Conference Proceeding, Department of fisherie Bangkok, Thailand , and international Center for living aquatic resources management Manila,Phil., p.335- 339 .

Hashish, A.I.,Arnaout M., Hafez, F.A. and Radwan, M.E. (1997) . Effect of mechanical nutrition and aeration on fish production.5 Conference of Misr Soc. Agric . Eng., 14 (4) : 234- 244 .

Hepher, B. and Prugining , Y. (1981). Commercial Fish Farming , with special refereuce to fish culture in Israel. J. Wiley , New York , 261 pp.

Lovell, R. T. (1989). Diet and fish husbandry. In Fish Nutrition (ed.by J.E.Halver), pp.549-604. Academic Press. Inc., New York, USA.

Mires . D. (1995) . The Tilapias . In C . E. Nash and A.J.Novotny (editors). Production of Aquatic Animals, pp. 133-152.

NACA. (Network of Aquaculture Center in Asia) (1989). Integrated fish farming in China NACA, Technical Manual 7, Bangkok, Thailand.

N.R.C. (1983). Nutrient Requirements of Warmwater Fishes and Shellfish. Nat. Acad. Sci. Washington. D.C.

Pillary T.V.R.(1990). Aquaculture Principles and Practices Pub. by arrangement with the UN – FAO.

Radwan M.E. (1997) . Mechanical nutrition and aeration of fish culture M.S.C.Th. in Agric Sci. Dept., Fac. of Agric., Zagazig Univ. (102-109) .

Sampath, K. (1984). Preliminary report on the effect of feeding frequency in *Channa striatus*. Aquacult., 40: 301-306.

SAS, (1987). SAS user's guide: Statistics, version 6. SAS Institute Inc., Cary, NC,USA .

Wang, K.W. ; Takeuchi, T. and Watanabe, T. (1985). Optimum protein and digestible energy levels in diet for (*Tilapia nilotica*). Bull. Soc.Sci. Fish., 51(1):141-146.

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أثر طرق ومعدلات التغذية على أداء النمو وكفاءة تحويل الغذاء لأسماك البلطى النيلى وحيد الجنس تحت نظام الاستزراع شبه المكثف

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* قسم الاستزراع السمكى بالمعمل المركزى لبحوث الثروة السمكية بالعباسة – أبو حماد – شرقية – مصر

** قسم تغذية الأسماك بالمعمل المركزى لبحوث الثروة السمكية بالعباسة – أبو حماد – شرقية – مصر

أجريت هذه الدراسة لفحص تأثير طرق ومعدلات التغذية على أداء النمو، الكفاءة الغذائية والتقييم الاقتصادى لأسماك البلطى النيلى وحيد الجنس المربى فى الأحواض الترابية مع استخدام التهوية الإضافية ، وتمت التجربة فى تسعة أحواض أرضية مستطيلة الشكل ، مساحة كل حوض على حده واحد فدان ممثلة لتسعة معاملات ، ثلاث طرق تغذية مختلفة (تغذية يدوية ، تغذية أوتوماتيكية وتغذية حسب الحاجة) فى داخل كل معاملة تم استخدام ثلاثة معدلات تغذية (٣، ٤، ٥ % من وزن الأسماك الكلى) وغذيت الأسماك على عليقه تجارية احتوت على ٢٥% بروتين خام وطاقه كلية ٤١٠٠ كالورى / كجم علف ، بالإضافة إلى التسميد العضوى بزرق الكتكوت البياض بمعدل ١٠٠كجم/ فدان/ شهر، وزعت على مرتين . امتدت التجربة ستة عشر أسبوعا من ٦/١ إلى ٩/٣٠ /٢٠٠٢ م ، واستخدمت بدالات التهوية بقوه ١ حصان لزيادة الأوكسجين المذاب فى الأحواض ، وكان يتم تغير المياه للأحواض بالكامل كل ٣٠ يوم ، وكان من أهم النتائج المتحصل عليها ما يلى :

بصفه عامة أظهرت القياسات المأخوذة لدراسة جودة مياه الأحواض التى بها الأسماك أن مياه الأحواض كانت مناسبة لنمو أسماك البلطى النيلى بصورة طبيعية .

أظهرت النتائج المتحصل عليها فى نهاية الدراسة لأداء أسماك البلطى النيلى متمثلة فى وزن الجسم، الزيادة فى الوزن ، ومعدل النمو، والمحصول السمكى الكلى ، وكذلك كمية الغذاء المستهلكة، ومعدل تحويل الغذاء كلها أوضحت أن الأسماك التى غذيت بطريقة التغذية الأتوماتيكية بمعدل ٥ % من وزن الجسم فى اليوم قد أعطت نموا وأداء للنمو أفضل من الأسماك التى غذيت بطريقة التغذية حسب الحاجة والتغذية اليدوية عند مستويات تغذية ٣ و ٤ % من وزن الجسم ، والتقييم الإحصائى للنتائج أوضح أن الاختلافات بين المجموعات التجريبية كانت معنوية .

النتائج المتحصل عليها أوضحت تفوق المعاملة الثامنة (٥ % معدل تغذية مع طريقة التغذية الأوتوماتيكية) فى العائد الاقتصادى مقارنة بالمجموعات التجريبية الأخرى .

النتائج المتحصل عليها أوضحت تفوق المعاملة الثامنة (٥ % معدل تغذية مع طريقة التغذية الأوتوماتيكية) فى العائد الاقتصادى مقارنة بالمجموعات التجريبية الأخرى .

وتوصى الدراسة باستخدام طريقة التغذية الأتوماتيكية مع معدل تغذية ٥ % من وزن الجسم لأسماك البلطى النيلى وحيد الجنس المستزرع فى الأحواض الترابية بكثافة تربية ٥٠ سمكه/ م^3 مع استخدام التهوية الإضافية وذلك لزيادة الأوكسجين الذائب فى ماء الحوض ، وذلك للحصول على أعلى إنتاجيه من الأسماك وأعلى عائد إقتصادى .