EEEECT OF FEEDING RATES ON PERFORMANCE OF MONO-SEX NILE TILAPIA REARED IN FERTILIZED EARTHEN PONDS.

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SUMMARY

A 2 X 3 factorial experiment was conducted with Nile tilapia (*Oeochromis niloticus* L.) fingrlings using 4 and 5% feeding rates daily each with three supplementary inorganic fertilization (triple super phosphate) at 0, 3 and 6 kg per pond weekly each in two ponds (2000 m^2 per pond). Each pond was stocked with 12000 fish per treatment. Fish were fed on diet (25% CP) four times in four positions a day at the treated rates during the experimental period (180 days).

There was a significant ($P<0.05$) interactive effect of feeding rates and fertilization treatments on growth, weight gain, survival, yield and body composition. The economic effectiveness also varied among treatments. Feed conversion ratio (FCR) and protein efficiency ratio values were negatively correlated with feeding rates. The lowest feeding rate (4%) produced significantly lower protein and lipid contents in fish body than others. The optimum feeding rate for Nile tilapia fingerlings reared in fertilized pond with 6 Kg triple super phosphate was 4% of total biomass. It is concluded that, feeding rate is the main differentiating factor in all growth, feed utilization, carcass composition parameters and fish production cost.

***Keywords** : Oreochromis niloticus, growth , feeding rate and body composition.*

INTRODUCTION

Fish feeding is one of the most important factors in commercial fish production because feeding regime may have consequences on both growth performance and feed wastage (Tsevis *et al.*, 1992; Azzaydi *et al.*, 2002). Moreover, knowledge on the optimum feeding rate is important not only for best growth and feed efficiency, but also for preventing water quality deterioration as a result of excess feeding (Ng et al., 2000; Webster et al., 2002).

Ammonia is the main end product of nitrogen metabolism in teleosts (Foster and Goldstein, 1969), and most teleosts fish are highly sensitive to ammonia toxicity (Handy and Poxton, 1993). Detailed knowledge on the impact of water quality factors on basic production characteristics such as growth performance, feed conversion ratio and fish health is therefore needed in order to increase intensive fish culture.

Phosphorus, though required in small quantities for aquatic biota, is the most important single element in water, it is an essential element required by all fish for normal growth (Begum *et al.*, 2003). Schaperclaus (1933) reported that denitrification by bacteria quickly broken down nitrogen in inorganic fertilizer add to ponds and nullified toxicity.

Tilapia culture is being practiced in most of the tropical, subtropical and temperate regions; great attention has been paid to tilapia culture in recent

years. Rapid growth rates, high tolerance to low water quality, efficient food conversion, ease of spawning, resistance to disease, and good consumer acceptance make tilapia a suitable fish for culture in Egypt.

The present study was undertaken to investigate the effects of varying feeding rates on the growth performance, feed conversion and body composition of Nile tilapia (*Oreochromis niloticus* L.) fingerlings reared in fertilized earthen ponds with triple super phosphate. It may also contribute to improve aquaculture management practices and increasing fish farm profitability.

MATERIALS AND METHODS

Feeding regimen and experimental design:

The production and feeding trial was conducted in 6 earthen ponds ($2000m^2$/pond), at stocking rate of 12000 fish in each, mono-sex Nile tilapia (*Oreochromis niloticus* L.) fingerlings weighing 1.81 g/fish, on the average were stocked in a farm located in Wady El-Netron, Elbehera Governorate.

Fish were fed a commercial diet for 180 days at rates of 4 and 5% of total biomass each in three ponds. The two feeding egimen consisted of feeding the supplemental diet in conjunction with triple super phosphate (TSP) as inorganic fertilization at three levels (0, 3 and 6 kg /pond). The fertilizer was broadcast over each of two ponds weekly. Seven days after initial fertilization each pond was stocked with Nile tilapia.

The experimental treatments were as follows: T1=4%feeding rate without TSP, T2=4%feeding rate+3kg TSP, T3=4%feeding rate+6kg TSP, T4=5%feeding rate without TSP, T5=5%feeding rate+3kg TSP, T6=5%feeding rate+6kg TSP

The daily amount of feed was weighed and delivered to the fish by hand four times (9.00, 11.00, 13.00 and 15.00 hrs.). Fish were weighed biweekly and daily feeds were adjusted after each weighing.

The proximate analysis for crude protein, ether extract, ash, crude fiber and moisture contents was conducted according to AOAC (1990). Gross energy was estimated using values of 4.0 K cal/g carbohydrate, 9.5 K cal/g lipid and 5.7 K cal/g protein as reported by NRC (1993). The chemical analysis of diet on dry matter basis (%) was 25.33 crude protein(CP), 6.51 ether extract (EE), 10.92 ash, 7.39 crude fiber (CF) and 4.35 K cal gross energy (GE). The diet contained 25%CP which is the optimum level for Nile tilapia fingerlings (Santiago and Laron, 2002).

Experimental ponds and water quality measuments:

Experimental ponds were supplied with ground water containing about 0.903 % salinity. The water remained static, except for the periodic replacement to the off set evaporation (=2% or the volume/day). Water temperature, dissolved oxygen levels and pH measurements were taken at dawn through the mid-afternoon period twice weekly for the 24 week duration of the trial. (May to November 2003) the range of values for these parameters throughout the trial were 26-32 ^{0}C, 3.28-7.08 ppm and 7.5 -8.6, respectively.

Dissolved oxygen (mg/l) and pH were measured directly by using a digital dissolved oxygen meter (Model YSI-58, USA) and pH meter (Jenway model - 3020), respectively. Transparency (cm) was measured with secchi disc of 1 m diameter.

Body composition analysis:

At the start of the trial, fifteen fish were taken randomly and at the end of the feeding trial, all fish in each pond

were netted, weighed to determine pond yieid and final body composition was analyzed according to AOAC (1990).

Fish sampling and harvesting:

Fish were sampled at biweekly intervals and weights of 15 fish of each treatment were measured and also to record the health condition. All ponds were completely harvested after 6 months of rearing, first by seine net and then by draining out of the ponds. All fish of each pond were counted and measured for weight individually to assess the rate of survival and production.

Statistical analysis :

Results of fish growth rates, feed utilization efficiency and body composition were analyzed using the general linear model procedure of completely random design (SAS, 1995). Differences among treatments were analyzed by Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

The effects of feeding levels and inorganic fertilizer (TSP) on body weight and body weight gain are shown in Table (1). The body weight gain (g) of Nile tilapia was higher in ponds received 5% feeding rate and 6 Kg of TSP. The survival rates of fish were higher in T3 and T2 groups (98.7 and 98.9%, respectively). The net yield of fish / Kg / feddan in 180 days experimental period, which was extrapolated from the production from 2000 pond, was significantly higher ($P< 0.05$) in T5. In contrast the significantly lower fish yield was recorded in T1 group. These result indicated that of the effects of high feeding rate and inorganic fertilization used in the experiment, despite having similar number of fish, feeding rate is more effective factor in increasing fish yield, this might be due to greater abundance of phytoplankton and increased density of zooplankton preyed upon by planktovorous fish. Fertilization with phosphorus resulted in great increases in fish production, which can be attributed to greater availability of natural food in all ponds received phosphorus. Also Schaperclaus (1933) reported that denitrification by bacteria quickly broken down nitrogen in inorganic fertilized ponds and decreased its effect in spite of popular belief that phosphorus is the most important element in pond fertilization. Treating ponds with phosphorus alone is thought to promote nitrogen fixation to such an extent that additional nitrogen is unnecessary (Hickling , 1962 ; Boyd and Sowles, 1978).

These results suggest that a feeding rate of 5% not only provided necessary nutritional components and energy for better fish growth but also improved gross production on the other hand, under intensive rearing condition and particularly when water is limited, ambient ammonia concentrations may reach levels that limit fish survival and growth (Haywood, 1983). Ammonia and urea are the two main nitrogenous products excreted by teleost fish (Foster and Goldstein, 1969). In the present study, high level of ammonia inT4, T5 and T6 groups as a results of high level of feeding rate (5%) may be denitrificated by bacteria quickly by using 6 Kg TSP and reduced the toxicity of ammonia. In addition, Sirol et al. (2000) found that, growth rates of red tilapia fingerlings were increased while FCR were impaired with increasing feeding levels from 4 to 16% .

The reduction of feed conversion ratio with increasing feeding levels in the present study may be due to the increasing rate of feed passage through the digestive tract and depressed feed

digestibility and metabolism, leading to poor feed efficiency, as reported by Macintosh and Silva (1984) and El-Sayed (2002).

Fish fed diets at 5% rate daily had higher growth, feed intake and higher feed conversion ratio (FCR) than other groups. The FCR of Nile tilapia reared in fertilized ponds was significantly decreased by feeding rate, but it increased protein and energy efficiency, which is reflected in higher growth rate in Nile tilapia reared in T3, T2, T6 and T5 groups compared with T1 And T4 groups (Table, 2).

The fish cultured in T4 fed lower nutrients and energy than others due to the lower concentration of natural food produced by higher level of TSP in T6 and T5 groups. The results indicated that nutrients in inorganic fertilized ponds were more productive than that in low level of feeding rate also, this might be due to he fact that Nile tilapia is planktovorous fish species. Similar results were reported by Coyle *et al.* (2004) and Abd El-Ghany and Ahmed (2002).

The carcass protein of fish fed lower feeding rates were significantly lower than that maintained at higher feeding rates in fertilized ponds, it was found that increasing TSP increased CP contents in Nile tilapia bodies (Table, 3). Also carcass lipid and GE increased with increasing dietary levels, whereas moisture and ash were inversely related to feeding rates among all groups. A better understanding of the role of natural productivity in Nile tilapia nutrition reared in fertilized ponds could lead to management strategies that selectively enhance desirable food organism and lower feeding rate by utilizing inorganic fertilizer (TSP) and supplementary feeds.

Water quality data for the 6 treatments are summarized in Table (4). The water temperature in T1 ranged from 26.27 - 32.15 ^{0}C.The variations in temperature among the treatments were found similar ($P< 0.05$) and were within the suitable range of 26.23 - 32.16 ^{0}C for production of plankton and growth of fish (Begum et al.,2003; Abd El-Ghany and Ahmed, 2002). The water transparency was found to vary highly among treatments, relating to the phytoplankton abundance and productivity level. The mean water transparency was lower in ponds treated with low TSP and fed on 4% feeding rate showing an inverse relation with the chlorophyll- a content. The variations in pH in all treatments were within the productive range (Hossain et al., 1997). The dissolved oxygen concentrations in ponds fertilized with 6 kg TSP were lower at the morning, which might be associated with the consumption of O_2 from water column due to heterotrophic activities of relatively high loaded plankton. On the other hand, high levels of dissolved oxygen in ponds received 5% feeding rate and 6 Kg TSP during the afternoon may be correlated with increasing biomass of photosynthetic organisms, as reported by Begum *et al.* (2003).

The results of the economic analysis showed that, the net profit was increased with decreasing feeding rates and reached a maximum when fish fed on 4% daily in fertilized ponds with TSP (3kg/pond) then declined slightly at feeding rate of 5% without inorganic fertilizer (Table, 5). In addition, the nutritional role of natural productivity is obviously important to maximize the national contribution in order to reduce feeding production costs (Chamberlian, 1995 and Collins, 1999).

This study has demonstrated there was an interaction between feeding rate and inorganic fertilizer. Overall, both are important in the determination of the growth performance and feed conversion

Table (1) : Effects of feeding rates and inorganic fertilizer (TSP) on growth performance of Nile tilapia (*Oreochromis niloticus*).

Treatments Fr-TSP	Final body weight g/fish	Gain g/fish	Daily weight increment g/ day/ fish	Survival %	Gross production Kg/ feddan
T1	226.25 ± 0.11 c	224.44 ± 2.10 c	1.25 ± 0.07c	96.7 ± 3.3	5513.36 ± 5.7 f
T2	235.28 ± 0.04 b	233.47 ± 0.00 b	1.30 ± 0.04b	98.6 ± 8.4	5846.04 ± 11.4e
T3	241.01 ± 0.15 b	239.20 ± 0.03 b	1.32 ± 0.02b	97.8 ± 6.9	5939.83 ± 7.4 d
T4	258.38 ± 0.20 a	256.57 ± 0.10 a	1.43 ± 0.05 a	97.7 ± 0.7	6352.06 ± 20.4 c
T5	259.29 ± 0.11a	257.48 ± 0.31 a	1.43 ± 0.11 a	98.7 ± 1.9	6462.23 ± 38.3a
T6	262.56 ± 0.09 a	260.75 ± 0.09 a	1.44 ± 0.03 a	96.8 ± 3.8	6404.79 ± 50.4 ab

Means with different letters in the same column are significantly different (P< 0.05) .
The initial body weight was 1.81 g/fish
Fr= feeding rate % (4%, 5%)
TSP = Triple super phosphate Kg (0.0 kg, 3.0 kg, 6.0 kg)

Table (2): Effect of feeding rate and TSP fertilizer on feed intake (Kg) and feed utilization efficiency of Nile tilapia during the trial (180 days).

Items	T1	T2	T3	T4	T5	T6
Feed intake g / fish	424.19 ± 8.12f	434.25 ± 6.32e	442.52 ± 1.25d	656.82 ± 11.30a	628.25 ± 2.15b	615.37 ± 6.19c
Feed conversion ratio (FCR)	1.89 ± 0.01e	1.86 ± 0.00d	1.85 ± 0.01d	2.56 ± 0.03a	2.44 ± 0.02b	2.36 ± 0.04c
Protein efficiency ratio (PER)	2.16 ± 0.12c	2.15 ± 0.00b	2.18 ± 0.01a	1.55 ± 0.00 f	1.66 ± 0.02e	1.73 ± 0.00d
Energy intake kcal GE/ fish	1783.85 ± 11.2c	18.62.37 ± 19.8b	1882.29 ± 3.50a	2835.6 ± 5.9 b	2656.2 ± 4.1e	2590.6 ± 18.2f
Energy efficiency ratio (EER)	0.12 ± 0.01b	0.13 ± 0.00a	0.13 ± 0.00a	0.09 ± 0.00d	0.10 ± 0.0 c	0.10 ± 0.0c

Mean with different letters in the same column are significantly different (P< 0.05).
FCR: feed intake / wet weight gain .
PER: wet weight gain / protein intake .
EER: wet weigh gain/ Energy intake.

Table (3) :The effects of feeding rates and inorganic fertilizer on the body composition (%) of Nile tilapia (*Oreochromis niloticus* L.).

Treatments	Moisture %	Crude protein %	Ether extract %	Ash %	GE Kcal
T1	74.26 ± 1.35 a	15-173 ± 9-63 cd	5.97 ± 0.24 d	4.04 ± 0.02 a	128.64 ± 1.36 d
T2	74.05 ± 2.11 a	15.81 ± 0.60 c	6.09 ± 0.45 c	4.05 ± 0.00 a	12.36 ± 0.00 d
T3	72.39 ± 0.92 ab	16.28 ± 0.53 b	6.35 ± 0.00 bc	4.98 ± 0.03b	153.13 ± 2.60 bc
T4	72.59 ± 1.27 b	16.31 ± 0.90 b	6.64 ± 0.21 ab	4.46 ± 0.05c	156.00 ± 5.50 ab
T5	72-25 ± 0.57 c	16.62 ± 0.11 a	6.77 ± 0.07 a	4.36 ± 0.00 c	157.11 ± 0.50ab
T6	72.62 ± 0.93 d	16.7 ± 0.52 bc	6.82 ± 0.59 a	3.80 ± 0.03 d	160.30 ± 8.41 a

Means with different letters in the same column are significantly different (P< 0.05).
* GE (gross energy was estimated as Kcal per 100 g weight gain of fish).

Table (4): Means of water quality parameters of ponds water under three different inorganic fertilizers (TSP) and two feeding rates.

Parameters	T1	T2	T3	T4	T5	T6
Water temperature ^{0}C	26.3-32.2	26.2-32.1	26.3-32.1	26.3-32.2	26.2-32.2	26.2-32.2
Dissolved oxygen (mg/l)	3.41-6.88	3.40-6.96	3.31-7.11	3.26-7.01	3.17-7.21	3.13-7.33
pH	6.82-8.89	6.85-8.59	6.89-8.57	7.08-8.31	7.01-8.44	7.11-8.49
Transparency (cm)	31.71	20.21	18.12	30.15	17.33	15.89

Table (5): The cost-benefit analysis of Nile tilapia (*Oreochromis nilotcus L.*) reared in fertilized earthen ponds.

Items	T1	T2	T3	T4	T5	T6
Feed intake kg	4962.02	5177.92	5232.71	7741.44	7507.88	7195.64
Feed intake kg LE	7443.03	7766.88	7849.07	11612.16	11261.82	10793.46
Fertilizer LE	-	72	144	-	72	144
Cost of fish LE	1200	1200	1200	1200	1200	1200
Total yield Kg	2625.41	2783.83	2828.49	3024	3077	3049
Total yield LE	19690.58	20878.73	21213.07	22680.00	23077.50	22867.50
Benefit LE	11047.55	11839.85	12020.61	9867.84	10543.68	10730.50

- The estimation was based on local market retail price (at the current time) of feed, fertilizer and fish (2003).
- Means of market sale value of harvested fish was set at 7.5 LE/kg.

ratio of Nile tilapia. In spite of the fact the higher feeding rate (5%) provided better growth for Nile tilapia in fertilized ponds with TSP.

The current study demonstrated that the optimal feeding rate for Nile tilapia (1.81 g/fish) fingerling was 4% in fertilized earthen pond with 6 kg TSP (T3), which resulted in reducing feeding cost of production.

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أثر معدلات التغذية على أداء النمو للبلطي النيلى وحيد الجنس المربى في الأحواض الترابية المسمدة

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تم تصميم التجربة في نظام ٢ × ٣ على إصبعيات البلطي النيلي باستخدام معدلات تغذية ٤ و ٥% يوميا كلا من ثلاث مستويات إضافية من التسميد المعدني (سوبر فوسفات الثلاثي) صفر ، ٣ و ٦ كجم للمعاملة أسبوعيا كلا في حوضين (٢٠٠٠ متر مربع / حوض) تم استزراع الأسماك بكثافة ١٢٠٠٠ سمكة / للمعاملة واستخدمت العليقة الصناعية بمستوى بروتين ٢٥% في تغذية الأسماك مقسمة على أربعة وجبات يوميا لمدة ١٨٠ يوم. كان هناك تأثيرا معنويا بين معدلات التغذية والمعاملات السمادية على أداء النمو ، الزيادة الوزنية ، معدلات البقاء ، الإنتاج السمكي وتحليل جسم الأسماك اختلف أيضا العائد الاقتصادي للمعاملات وكانت معاملات التحويل الغذائي ومعدلات كفاءة البروتين ذات علاقة سلبية مع معدلات التغذية . كان معدل التغذية ٤% ذو أثر معنوي على انخفاض البروتين والدهن الناتج في الأسماك عن المعاملات الأخرى أن معدل التغذية لاصبعيات البلطي النيلي الذكرية في الأحواض المسمدة بـ ٦كجم سوبر فوسفات ثلاثي هو ٤% من وزن الجسم . ويمكن أن نستخلص من هذه الدراسة أن معدل التغذية عامل مؤثر على نتائج النمو ، الاستفادة الغذائية ، تحليل جسم الأسماك وتكلفة الإنتاج السمكي