EFFECTS OF STOKING RATES AND SUPPLEMENTARY FEED ON THE GROWTH PERFORMANCE OF BLUE TILAPIA (*OREOCHROMIS AUREUS*) AND GRASS CARP (*CTENOPHARYNGODON IDELLA*) REARED IN EARTHERN PONDS

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Abstract

This study was carried out to investigate the optimizing of stocking density of grass carp (164.3 g/fish) at a rates of 100, 200 and 300 fish/pond with 1000 of Blue tilapia (11.39g/fish) reared in earthen ponds and test the effects of rabbit manure as organic fertilizer or using supplementary feed and its effects on the growth performance of fish during 14 weeks of the trial (Table, 1). Fish were stocked in 18 earthen ponds each of a total area 1000 m^2 (three ponds/treatment). Rabbit manure as organic fertilizer was applied in three treatments by a rate of 40 kg/pond (T1, T2 and T3) weekly during the experimental period (14 weeks). Also, supplemental feeding was tested in polyculture system throughout the three treatments (T4, T5 and T6) at a rate of 3% of total biomass of fish, four times daily (9.00, 11.00, 13.00 and 15.00 hr.).

Results obtained can be summarized on the following

- Treatment applied had significant effect on the final body measurements of tilapia and carp at a lower stocking density and supplementary feed.
- Feeding Blue tilapia on supplementary feed increase total production at T6 (higher stocking density of grass carp). The final body weight of Blue tilapia was higher with supplemental feeding in all treatments tested.
- Increasing final body weight of Blue tilapia Blue tilapia with increasing stocking density of grass carp. On the hand, final body weight of grass carp decreased with using supplementary feed at higher stocking density (T6), but final yield increased.
- All water quality parameters evaluated were within acceptable limit for fish culture in pond water.

Key words: Blue tilapia, grass carp, supplementary feed and organic fertilizer.

INTRODUCTION

Polyculture of fishes in pond supplied directly with manure is widespread practice in many countries (Baradach, *et al.*, 1972). These systems usually use a combination of planktopagic silver carp, bighead carp, macrophytophagic grass carp, benthphagic common carp and omnivorous tilapia sp. to take advantage of the various feeding pond riches (Malecha *et al.*, 1980). In addition, the polyculture aims to increase productivity by a more efficient utilization of the ecological resources in the aquatic environment (Lutz, 2003).

Tilapia is regarded as an omnivorous species and capable of feeding on benthic and attached algal and detrial aggregates (Azim *et al.*, 2003 & Uddin *et al.*, 2007).

When the concentration of different species are adequate in the polyculture pond, the growth rate of plankton, macrophytes, benthos and nekton (other than the stocked fishes) keep pace with the rate of consumption by the cultured fisher (Peter, 1995).

The successful use of grass carp to control aquatic plants was reported by (Opuszynski, 1972).

Optimal fertilization is a management protocol to enhance biological productivity using organic fertilizer. Also, fertilization rate is the amount of organic matter that can be cost-effective and utilized in pond ecosystem without having any harmful effect on water quality as well as on fish growth (Bhakta *et al.*, 2004). Therefore, the nutritional role of natural productivity is obviously important to maximize the nutritional contribution in order to reduce feeding cost (Collins, 1999).

The objective of the present study is to evaluate the effects of stocking densities, organic fertilizer and supplementary diet on the growth performance of Blue tilapia and grass carp reared in earthen ponds.

Natural forage organisms usually contain a high proportion of protein, with most averaging 50-60% protein on a dry matter basis (Hepher, 1989). The biological value of the protein in those natural food items is also high as amino acid profiles closely resemble requirements of the consuming species (De Silva *et al.*, 2006).

Weekly gain is inversely related to stocking rate, as already noted by Lanari *et al.*, (1989).

MATERIALS AND METHODS

The experiment had 2 x 3 factorial design, the first factor was presence or absence of fertilizer, the second factor was supplementary feed each with three stocking densities, 1000 Blue tilapia plus 100 grass carp, 1000 Blue tilapia plus 200 grass carp and 1000 Blue tilapia plus 300 grass carp/pond. The experiment was carried out in 100 m^2, 1 m depth, earthen ponds at Wady El-Nitron aria, El-Behera Governorate for a period of 14 weeks between September and November 2007. Ponds were assigned randomly to the six treatments in triplicate (three ponds in each treatment).

Fish stocking and management:

Seven days after fertilization each pond was stocked with Blue tilapia (*Oreochromis aureus*) and grass carp (*Ctenopharyngodon idella*). The stocking densities were 1000 Blue tilapia plus 100 grass carp, 1000 Blue tilapia plus 200 grass carp and 1000 Blue tilapia plus 300 grass carp each in two treatments. The initial weights were 11.39 and 164.30 g/fish for tilapia and carp, respectively.

Feeding:

The diet used in the daily feeding treatments (T4, T5 and T6) was formulated with 28.41% CP and 3910.02 kcal/kg GE. Fish were fed with 3% of total biomass in T4, T5 and T6 treatments, four times daily (9.00, 11.00 , 13.00 and 15.00 hr.), feeding was adjust to the change in weight biweekly. The experimental diet and rabbit manure were analyzed according to AOAC (Table, 2).

Culture techniques

The fertilization program

Rabbit manure (12.03 CP, 1.15 EE, 31.16 CF, 19.41ash and 36.25%NFE on dry matter basis), spread on the bottom of T1, T2 and T3 treatments at a rate of 40 kg/pond weekly. The ponds (T1, T2 and T3) were then filed with water (up to 40 cm in depth) and after four days the level of water in all ponds were filled to 1 m from ground water. Fish were then stocked and the water out-let was protected with nylon enclosures to prevent unwanted species and escape of cultured fish. To maintain an ideal population of natural feed in T1, T2 and T3 ponds, several additional application of rabbit manure as organic fertilizer were applied weekly on the morning. The experimental treatments were shown in table (2).

Growth and yield

Seven weight determination, measurements and feed adjustment, samples of at least 10% of fish from each species were collected periodically (every 2 weeks) with a net. The fish were weighed, measured and immediately returned to the water pond. The total fish weight of sampled fish multiplied by the total number of fish initially stocked. At the end of the experiment (14 weeks), all fish were harvested and the total number, weight and size of each fish species were determined. Survival rate and yield data were then calculated.

The growth and yield indexes measured an or calculated were: total biomass (g), mean body weight by species (g), weight gain (Wg: W1- W0) specific growth rate (SGR: 100-{Ln(W1)-Ln(W0)/t}) where W1 is final weight, W0 is initial weight and t is days culture as mentioned previously (Barcellos *et al.*, 2004). The survival rate and condition factors (k) were also determined as follow: K= {weight g/ length^3 cm}x 100.

Water quality measurements

Water temperature and dissolved oxygen concentrations were measured two times a day (8.00 and 16.00 hr.) at a depth of 30 cm with an oxygen meter (451 model 550 A, yellow Spring Instruments, USA). Water transparency (Secchi dish) was measured also. Every week total ammonia-N was measured with colorimetric tests.

Statistical analysis

The data obtained are presented as treatment means $\pm$ standard error of mean. The analysis was carried out by applying the computer program Harvey (1990). Differences among means were tested for significance according to Duncan' s multiple rang test (1955).

RESULTS AND DISCUSSION

Table (4) are shown the effects of polyculture of Blue tilapia with grass carp on the growth weight during the experimental periods (14 weeks).

The initial weight of different species was similar, ranging from 11.1 to 11.4 g/fish in Blue tilapia and 163.7 to 164.5 g/fish in grass carp. In contrast, the final weight of different species in different treatments showed differences, with a pond effect on the growth of different species. Blue tilapia final weight varied from 98.2 to 178.3 g (T3 and T6). The grass carp from treatment T1 had the higher weight in comparison to the other treatment. Blue tilapia grew better in T6 (higher stocking density of grass carp) which has the supplementary feed, probably because these specie did not find compete for artificial feed. Lutz (2003) reported that the overlapping of food preferences among species may be a problem in polyculture. Moreover, grass carp achieved best performance in T1 (lower stocking density with fertilizer).

Survival rates obtained in this research did not show a clear treatment effect. They were higher than those reported by Soltan *et al.*, (1999) with Nile tilapia.

Results data in Tables (3, 4 and 5) also referred to the higher body weight, length and depth obtained with fish fed the supplementary feed compared to the fish stocked in fertilized ponds (T1, T2 and T3). These results may be attributed to the availability of supplemental feeding to fish which get the nutrient requirements. Under the polyculture system of Nile tilapia and silver carp, Soltan (1998) had the same results for Nile tilapia and the opposite results were obtained with silver carp stocked with Nile tilapia in the same pond.

Regardless of fertilizer and supplemental feeding, body weight, length and depth were negatively related to the increasing stocking density of grass carp.

However, total fish yield at harvesting increased (T6 and T3), these results data (Table 3, 4 and 5) may lead us to recommended that, lower stocking densities of grass carp with tilapia up to the marketable size is suitable of the short rearing period with using supplementary feed otherwise higher stocking densities should be need longer time during the culture season of fish. Abdel-Wares (1993) reported that, final body weight of Nile tilapia decreased with increasing stocking density but the total yield increased.

Averages condition factor (k) are shown in Table (6). The K values of Blue tilapia in the present study were higher in T6, T5 than T1 but the difference was not significant (P>0.05). The lowest K values were obtained b T2, T3 and T4 with no statistical difference were found between groups in each treatments. Also, it was found that k value of grass carp was the lowest compared with k values of Blue tilapia. In treatments T1and T2, the k values of grass carp were higher than other treatments. It could be noted that organic fertilizer at both low and high stocking densities of grass carp in the present study promote growth performance of these fish. These growth values were obvious in Blue tilapia which had supplementary feed with higher stocking density of grass carp. In our experiment, the presence of grass carp had positive effects on all growth parameters of Blue tilapia.

According to Kestmont (1995) the growth and yield of each species may be high in polyculture than in monoculture because of positive interactions among species. De Silva (2006) reported that, Nile tilapia grew better in polyculture system with no common carp, probably because these species compete for artificial feed. This could explain the superiority of grass carp yield in treatments which achieved rabbit manure as organic fertilizer.

The values of the growth coefficient k (Table, 6) show the general trend in growth rates observed in this trial during the culture period. Approximation to a linear trend in growth (constant growth rate) is indicated by k values close to 1.0, whereas departure from 1 means either increasing rate or decreasing weight gain (Hernandez *et al.*, 1995).

Te Blue tilapia was the fastest growing fish under these treatment conditions. On the other hand, growth performance of grass carp was higher in fertilized ponds. These results are in agreement of Boyd (1973) who found that the increase in fish production in fertilized ponds has been attributed to an increase in natural food. Also, the increase phytoplankton production has been improved by using organic fertilizer.

Results presented in Table (7), revealed that artificial feed application in Blue tilapia reared in earthen ponds improved specific growth rate values as compared with other treatments in fertilized ponds at lower stocking densities. Increasing in the growth performance by using supplemental feeding compared with other treatments (Fertilized ponds) was also found by Hussouna *et al.*, (1988) and Uddin *et al.*, (2007).

The specific growth rate values of Blue tilapia indicated that supplementary feed increased the availability of all nutrients to fish when stocked in un-fertilized ponds, the lowest value was obtained by grass carp with high stocking density (T6) in un-fertilized ponds. Also the higher values of specific growth rate was observed in T6 for Blue tilapia but lower value was obtained in un-fertilized pond (T1), on spite of low stocking density of grass cap in this treatment.

As presented in Table (8) regardless of stocking density of fish, total yield as affected with treatment applied in earthen ponds and that calculated per pond (1000 m^2) were found 180, 207 and 228 kg (T1, T2 and T3) which fertilized with rabbit manure. On the other hand, the total yields were higher in T4, T5 and T6 compared with fertilized ponds with the same stocking densities. These results indicated that increasing the stocking density of grass carp in un-fertilized ponds increased the total yield in T5 and T6 ponds but the low yield in T4 may be due to grass carp was not able to get nutrients requirement in un-fertilized ponds. Also, Blue tilapia grew better in un-fertilized ponds (T4, T5 and T6 ponds). These results are in agreement with those reported by De Silva *et al.*, (2006), who found that grass carp increased total yield in fertilized ponds that had no supplemental feeding. Since Blue tilapia grew better in other treatments because grass carp did not compete for artificial feed. Also, Lutz (2003) reported that the overlapping of food preferences among species may be a problem in polyculture. Moreover, grass carp at lower stocking density achieved better results when culture with tilapia in un-fertilized ponds. As reviewed by Kestomont (1995), the association of carp and tilapia may increase the growth of carp. In polyculture systems, only a proper combination of ecological different species, at adequate densities, will utilize the available resources efficiently due to the minimization of synergestic fish-fish relationship and minimization of antagonistic ones (De Silva *et al.*, 2006).

Water quality data for the present study are summarized in table (9). The water temperature in all treatments ranged from 23.00-28.50. The variation in temperature among the treatments were found similar ($P < 0.05$) and within the suitable range of fish growth (De Silva *et al.*, 2006). All parameters were found within acceptable values for water ponds used in fish culture as reported by Boyd (1982).

The water transparency measurements by Scchi-dish were divided in three classes (< 30 cm, from 30 to 60 cm and > 06 cm) and the distribution in each pond are shown in Table (9). The secchi-dish water transparency ranged from 25.3 to 38.6 cm in the morning and from 24.8 to 43.1 cm in the afternoon, also with statistical differences between ponds. The T6 pond was presented the highest value of water transparency followed by T5 and T4. In water quality parameters a clear pond affect was noted, since all ponds were adjacent and receive water from the same source, no differences in water temperature could be detected, regarding to dissolved oxygen level, all morning and afternoon values were within the ideal range (above 6 mg/l). These values were considered high and can affect the primary production of the pond (Boyd, 1982). Te variation in different forms of nitrogenons (NH3-N) nutrients tested in the preset study was similar (P < 0.05) among treatments (Table 9) and within the limit of fish culture under the prevailing conditions (Boyd, 1982).

CONCLUSION

Based on the data presented herein, the most promising polycutture ratios seems to be that used in treatment 6 (1000 Blue tilapia with 300 grass carp belong with supplemental feeding). The interaction of Blue tilapia and grass carp had positive effects in all growth parameters evaluated. Also, Blue tilapia grew better in T6 ponds (un-fertilized pond) during 105 days.

Table 1. Stocking densities of Blue tilapia, *Oreochroms aureus,* and grass carp, *Ctenopharyngodon idella,* under the two feeding treatments.

Treatments	Stocking density	Pond No.	Stocking density per pond	Stocking density per feddan
Fertilization with rabbit	S1	1	1000 tilapia + 100 carp	4000 tilapia + 400 carp
manure	S2	2	1000 tilapia + 200 carp	4000 tilapia + 800 carp
(T1, T2 and T3)	S3	3	1000 tilapia + 300 carp	4000 tilapia + 1200 carp
Supplementary feed	S1	4	1000 tilapia + 100 carp	4000 tilapia + 400 carp
(3% of	S2	5	1000 tilapia + 200 carp	4000 tilapia + 800 carp
body weight) (T4, T5 and T6)	S3	6	1000 tilapia + 300 carp	4000 tilapia + 1200 carp

Table 2. Chemical analysis of supplementary feed and rabbit manure (on DM basis %).

Item	No. of samples	Rabbit manure Mean ± S.E.	Supplementary feed means ± S.E.
Moisture %	5	3.86±0.29	10.03±0.29
Crude protein %	5	12.03±0.45	28.41±0.45
Crude fat %	5	1.15±0.11	2.55±0.11
Crude fiber %	5	31.16±1.15	4.25±1.15
Ash %	5	19.41±0.27	9.33±0.27

Gross energy of diet and fertilizer was calculated according to NRC (1993) using the factors of 5.7, 9.5 and 4.0 K cal/g for crude protein, ether extract and crude carbohydrate, respectively.

Table 3. Effects of stocking densities, organic fertilization of rabbit manure and supplementary feeding on the body weight (g/fish) of Blue tilapia and grass carp.

Period (week) / Treatment	Blue tilapia							
	0	2	4	6	8	10	12	14 weeks
T1S1	*11.3±0.7	20.5±0.8	35.7±0.9b	54.8±1.3c	64.9±1.2c	74.9±1.3cd	35.4±1.4c	115.1±3.6c
T1S2	11.3±0.7	20.6±0.8	34.2±0.9b	47.0±1.3d	59.1±1.2de	71.1±1.3de	86.2±1.4d	104.6±3.6
T1S3	11.2±0.7	19.1±0.8	32.2±0.9b	45.2.±1.3d	65.0±1.2e	67.2±1.3e	81.0±1.4d	98.2±3.6c
T2S1	11.1±0.7	18.9±0.8	36.6±0.9b	50.4±1.3ed	63.9±1.2cd	80.4±1.3c	94.7±1.4c	114.7±3.6c
T2S2	11.4±0.7	22.1±0.8	45.1±0.9b	60.0±1.3b	76.6±1.2b	95.4±1.3b	116.5±1.4b	151.4±3.6b
T2S3	11.3±0.7	21.5±0.8	48.5±0.9a	66.4±1.3a	87.0±1.2a	110.2±1.3a	138.5±1.4a	178.3±3.6a
Overall mean	11.3±0.5	20.4±0.6	38.8±0.7	54.0±1.3	67.9±0.9	83.2±1.0	102.1±1.0	127.2±2.6
Period (week) / Treatment	**Grass carp**							
	0	2	4	6	8	10	12	14
T1S1	*164.0±10.1	192.0±13.8a	230.0±15.0	302.7±17.5a	323.8±204a	466.7±18.7a	521.6±15.0a	585.2±13.0a
T1S2	164.1±10.1	196.0±13.8a	235.5±15.0	300.1±17.5a	355.5±20.4b	403.2±18.7b	442.8±5.0b	489.0±13.0b
T1S3	163.9±10.1	196.2±13.8a	234.5±15.0	300.8±17.5a	348.7±20.4b	388.7±18.7b	418.7±15.0b	443.3±13.0c
T2S1	163.7±10.1	183.3±13.8ab	216.9±15.0	276.1±17.5a	324.8±20.4b	380.1±18.7b	427.3±15.0b	462.7±13.0c
T2S2	164.5±10.1	174.0±13.8a	294.4±15.0	220.9±17.5b	355.8±20.4c	396.2±18.7c	323.2±15.0c	352.9±13.0d
T2S3	164.6±10.1	174.4±13.7a	197.3±15.0	219.7±17.5b	334.4±20.4c	257.1±18.7c	279.4±15.0d	300.0±13.0e
Overall mean	164.0±4.2	186.3±5.7	218.1±6.2	270.1±16.1	318.8-±8.3	365.3±7.7	402.2±6.2	438.9±5.4

* Values are mean ± S.E a, b, c, d and e in the same column are significantly different ($P \leq 0.05$).

Table 4. Effects of stocking densities, organic fertilization of rabbit manure and supplemental feeding on the body length (cm.) of Blue tilapia and grass carp.

Period (week) / Treatment	Tilapia, aurea							
	0	2	4	6	8	10	12	14 weeks
T1S1	8.1±0.3	9.4±0.3c	12.4±0.3c	14.6±0.3b	15.4±0.3c	16.3±0.3c	17.5±0.3c	18.2.±0.3c
T1S2	8.1±0.3	10.1±0.3ab	12.6±0.3	13.5±0.3c	15.8±0.3d	15.9±0.3d	17.2±0.3c	17.9±0.3d
T1S3	8.2±0.3	10.3±03a	12.8±0.3c	13.6±0.3c	15.0±0.3d	15.9±0.3d	17.0±0.3c	17.4±0.3d
T2S1	8.1±0.3	9.7±0.3c	11.7±03b	14.4±0.3b	15.2±0.3d	16.7±0.3b	17.2±0.3c	18.5±0.3c
T2S2	8.1±0.3	10.6±0.3a	13.5±0.3a	14.4±0.3b	16.2±0.3b	17.7±0.3a	18.2±0.3b	19.6±0.3b
T2S3	8.1±0.3	10.5±03a	14.0±0.3a	15.2±0.3a	16.8±0.3a	17.9±0.3a	19.6±0.3a	20.9±0.3a
Overall mean	8.1±0.2	10.1±0.2	12.8±0.2	14.3±0.2	15.6±0.2	16.7±0.2	17.8±0.2	18.8±0.2
Period (week) / Treatment	Grass carp							
	0	2	4	6	8	10	12	14 weeks
T1S1	*25.30±0.70	25.33±0.84	27.67±0.85b	29.93±0.83a	32.90±0.77a	34.33±0.70a	34.60±0.62a	37.80±0.61a
T1S2	25.37±0.70	25.20±0.84	27.27±0.85b	31.60±0.83a	31.27±0.77abc	33.52±0.70ab	33.07±0.62b	35.10±0.61bc
T1S3	25.33±0.70	25.40±0.84	28.27±0.85a	30.31±0.83ab	32.27±0.77ab	32.80±0.70b	32.37±0.62b	34.07±0.61c
T2S1	25.33±0.70	25.80±0.84	26.80±0.85ab	28.6±0.83d	30.73±0.77bc	32.26±0.70b	34.27±0.62ab	35.40±0.61b
T2S2	25.37±0.70	25.33±0.84	25.80±0.85b	27.33±0.83c	30.33±0.77c	30.00±0.70c	30.72±0.62d	32.80±0.61d
T2S3	25.30±0.70	25.37±0.84	25.87±0.85b	27.43±0.83c	28.10±0.77d	29.13±0.70c	29.47±0.62d	29.70±0.61c
Overall mean	25.33±0.32	25.41±036	26.94±0.37	29.17±0.36	30.93±0.33	32.01±0.30	32.58±0.32	34.14±0.27

* Values are mean ± S.E a, b, c, d and e in the same column are significantly different ($P \leq 0.05$).

Table 5. Effect of stocking densities, organic fertilization of rabbit manure and supplemental feeding on the body depth (cm) of Blue tilapia and grass carp.

Period (week) / Treatment	Blue tilapia							
	0	2	4	6	8	10	12	14 weeks
T1S1	*2.70±0.11	3.44±0.08ab	4.12±0.09b	4.88±0.12ab	5.27±0.07a	5.06±0.06de	5.60±0.07b	6.02±0.10c
T1S2	2.70±0.11	3.49±0.08ab	4.18±0.09b	4.39±0.12c	5.06±0.07b	5.20±0.07cd	5.40±0.07c	5.90±0.10c
T1S3	2.72±0.11	3.20±0.08c	4.34±0.09ab	4.67±0.12bc	4.80±0.07c	4.95±0.06e	5.20±0.7d	5.48±0.10d
T2S1	2.68±0.11	3.30±0.0bc	4.22±0.09ab	4.95±0.12ab	4.80±0.07c	5.24.±0.06c	5.36±0.07d	5.84±0.10c
T2S2	2.69±0.11	3.56±0.08a	4.26±0.09ab	4.48±0.12c	5.38±0.07a	5.52±0.06b	5.75±0.07b	6.34±0.10b
T2S3	2.70±0.11	3.60±0.08a	4.46±0.09a	5.08±0.12a	5.33±0.07a	5.80±0.06a	6.32±0.07a	6.97±0.10a
Overall mean	2.69±0.05	3.43±0.04	4.26±0.04	4.74±0.05	5.11±0.04	5.30±0.03	5.61±0.04	6.09±0.05
Period (week) / Treatment	Grass carp							
	0	2	4	6	8	10	12	14 weeks
T1S1	*6.10±0.16	6.46±0.20	7.20±0.21a	7.78±0.21a	8.33±0.20ab	8.85±0.21a	9.47±0.25a	9.23±0.24a
T1S2	6.10±0.16	6.37±0.20	7.00±0.21b	7.27±0.21ab	8.67±0.20a	8.13±0.21b	8.97±0.25b	7.00±0.24e
T1S3	6.12±0.16	6.54±0.20	7.23±0.21a	7.49±0.21ab	8.23±0.20ab	8.03±0.21b	8.73±0.25b	8.03±0.24c
T2S1	6.10±0.16	6.54±0.20	7.23±0.21a	7.49±0.21ab	8.23±0.20b	8.03±0.21b	8.73±0.25b	8.03±0.24b
T2S2	6.13±0.16	6.36±0.20	6.57±0.21c	6.98±0.21b	7.87±0.20b	7.40±0.21c	7.50±0.25c	7.70±0.24d
T2S3	6.10±0.16	6.37±0.20	6.07±0.21c	6.96±0.21b	7.15±0.20c	7.22±0.21c	7.73±0.25c	7.25±0.24e
Overall mean	6.11±0.08	6.31±0.09	6.83±0.09	7.31±0.09	8.05±0.09	7.98±0.09	8.54±0.07	7.96±0.06

* Values are mean ± S.E a, b, c, d and e in the same column are significantly different ($P \leq 0.05$).

Table 6. Effect of stocking densities, organic fertilization of rabbit manure and supplemental feeding on the condition factor (K) of Blue tilapia and grass carp.

Period (week) / Treatment	Blue tilapia							
	0	2	4	6	8	10	12	14 weeks
T1S1	*1.88±0.06	2.63±0.11a	1.92.013b	1.75±0.07cd	1.79±0.06a	1.80±0.06b	1.79±0.08c	1.91±0.03ab
T1S2	1.88±0.06	1.97±0.11b	1.63±0.13c	1.93±0.07ab	1.82±0.06a	1.79±0.06b	1.70±0.08cd	1.81±0.06c
T1S3	1.81±0.06	1.70±0.11b	1.56±0.13c	1.80±0.07c	1.67±0.06b	1.68±0.06c	1.63±0.08d	1.84±0.06c
T2S1	1.88±0.06	1.95±0.11b	2.48±0.13a	1.67±0.07d	1.82±0.06a	1.67±0.06c	1.87±0.08b	1.81±0.06c
T2S2	1.81±0.06	1.84±0.11b	1.82±0.13c	1.96±0.07a	1.81±0.06a	1.73±0.06bc	2.06±0.08a	1.94±0.06a
T2S3	1.85±0.06	1.79±0.11b	1.74±0.13c	1.83±0.07bc	1.82±0.06a	1.92±0.06a	1.85±0.08b	1.95±0.06a
Overall mean	1.87±0.04	1.98±0.06	1.86±0.06	1.82±0.04	1.79±0.03	1.77±0.03	1.82±0.04	1.87±0.03
Period (week) / Treatment	**Grass carp**							
	0	2	4	6	8	10	12	14 weeks
T1S1	*0.99±0.05	1.17±0.06a	1.07±0.06ab	1.10±0.06b	1.06±0.06a	1.22±0.07a	1.26±0.05a	1.08±0.05a
T1S2	0.98±0.05	1.13±0.06a	1.15±0.06a	0.90±0.06c	1.08±0.06a	1.06±0.07b	1.21±0.05a	1.13±0.05a
T1S3	0.99±0.05	1.03±0.06bc	0.98±0.06c	1.08±0.06b	1.02±0.06a	1.08±0.07b	1.12±0.05b	1.12±0.05a
T2S1	0.99±0.05	1.11±0.06ab	1.06±0.06ab	1.21±0.06a	1.10±0.06a	1.8±0.07b	1.04±0.05c	1.01±0.05b
T2S2	0.99±0.05	1.08±0.06abc	1.09±0.06ab	1.04±0.06b	0.88±0.06b	1.03±0.07b	1.10±0.05b	0.98±0.05b
T2S3	0.99±0.05	1.00±0.06c	1.09±0.06ab	1.03±0.06b	1.04±0.06a	1.01±0.07b	1.08±0.5bc	1.13±0.05a
Overall mean	0.99±0.04	1.09±0.04	1.07±0.04	1.06±0.04	1.03±0.04	1.09±0.04	1.13±0.04	1.08±0.04

* Values are mean ± S.E a, b, c, d and e in the same column are significantly different ($P \leq 0.05$).

Table 7. Effect of stocking densities, organic fertilization of rabbit manure and supplementary feeding on the specific growth rate (SGR) of Blue tilapia and grass carp.

Period (week) / Treatment	Tilapia aurea							
	0-2	2-4	4-6	6-8	8-10	10-12	12-14	Average of total periods
T1S1	3.97±0.01b	3.70± 0.03 c	2.86 ± 0.02	1.13±0.01d	0.96±0.01c	1.61±0.01a	1.25±0.01c	2.22± 0.01 c
T1S2	4.00±0.02b	3.38± 0.03 c	2.12±0.01a	1.53±0.01ab	1.23±0.00c	1.28±0.00c	2.29±0.00a	2.12±0.02 d
T1S3	3.56±0.02b	3.48±0.02 c	2.26±0.03a	1.43±0.01 c	1.22±0.01c	1.25±0.01b	1.28±0.01c	2.07±0.03de
T2S1	3.55±0.01c	4.41±0.04b	2.13±0.01b	1.58±0.03ab	1.53±0.00a	1.09±0.00c	1.28±0.00c	2.22±0.00c
T2S2	4.41±0.02a	4.80±0.02ab	1.86±0.03c	1.63±0.01ab	1.46±0.00b	1.33±0.00b	1.75±0.01b	2.46±0.01b
T2S3	4.26±0.03b	5.42±0.01a	2.09±0.02b	1.80±0.02a	1.58±0.02a	1.52±0.02a	1.68±0.01b	2.63±0.03a
Period (week) / Treatment	Grass carp							
	0-2	2-4	4-6	6-8	8-10	10-12	12-14	Average of total period
T1S1	1.07±0.00b	1.18±0.00a	1.83±0.01a	1.75±0.01a	1.13±0.01a	0.74±0.00a	0.77±0.00a	1.21±0.01a
T1S2	1.19±0.00a	1.22±0.00a	1.62±0.01a	1.13±0.01b	0.84±0.00b	0.62±0.01b	0.66±0.00b	1.04±0.01ab
T1S3	1.20±0.01a	1.19±0.01a	1.66±0.01a	0.99±0.01b	0.72±0.00c	0.50±0.01c	0.38±0.01e	0.95±0.00b
T2S1	0.75±0.01c	1.12±0.02b	1.61±0.01a	1.08±0.02b	1.05±0.00a	0.78±0.00a	0.53±0.01c	0.99±0.01b
T2S2	0.37±0.01d	0.74±0.03c	0.85±0.01b	0.98±0.00c	0.98±0.00b	0.58±0.01b	0.59±0.00b	0.73±0.01c
T2S3	0.45±0.00d	0.79±0.00c	0.72±0.02c	0.43±0.00d	0.62±0.01d	0.55±0.01b	0.47±0.00d	0.58±0.00d
Overall mean								

* Values are mean ± S.E a, b, c, d and e in the same column are significantly different ($P \leq 0.05$).

Table 8. Effect of stocking densities, organic fertilization of rabbit manure and supplemental feeding on total yield of Blue tilapia and grass carp.

Treatments	Blue tilapia		Grass carp		Total	
	Yield (kg)	%	Yield (kg)	%	Yield (kg)	%
T1 S1	115.1	66.7	585.2	45.5	180	66.7
T1 S2	104.6	60.0	489.0	75.0	207	76.7
T1 S3	98.2	53.3	443.3	100	228	84.4
T2 S1	114.7	67.2	462.7	35.6	168	62.2
T2 S2	151.4	89.4	352.9	52.3	230	85.2
T2 S3	178.3	100	300.0	68.2	270	100

- Total yield of three ponds.

Table 9. Water quality parameters in ponds under six different treatments.

Parameter	T1	T2	T3	T4	T5	T6
Water temp. °C	25.60±0.01	25.61±0.29	26.1±0.31	25.61±02.13	25.91+3.21	25.69±1.93
Transparency cm	32.71±1.59e	30.32±1.34e	28.53±3.21d	38.21±2.11c	40.31±2.61b	43.69±5.13a
Dissolved oxygen mg/l	6.41±0.11	6.22±1.23	6.10±1.23	6.21±0.31	6.18±1.11	6.16±2.17
NH_3-N mg/l	0.02±0.00	0.01±0.00	0.01±0.00	0.01±0.00	0.02±0.001	0.02±0.00

Values are mean ± S.E a, b, c, d and e in the same raw are significantly different ($P \leq 0.05$).

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تأثير كثافات الاستزراع والأغذية الإضافية على أداء النمو للبلطى الأوريا ومبروك الحشائش النامى فى الأحواض الترابية

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١. *قسم بحوث نظم الاستزراع السمكى*
٢. *قسم بحوث تغذية الأسماك*

المعمل المركزى لبحوث الأسماك، العباسة، أبو حماد، محافظة الشرقية، مصر.

أجريت هذه التجربة لدراسة أفضل كثافة استزراع لمبروك الحشائش (١٦٤,٣ جم/سمكة) بمعدلات تسكين ١٠٠، ٢٠٠ و ٣٠٠ سمكة فى الحوض مع ١٠٠٠ سمكة من البلطى الاوريا (١١,٣ جم /سمكة) حيث تم استزراعهم فى أحواض ترابية مع دراسة تأثير استخدام التسميد العضوى (زرق أرانب) أو الأغذية الإضافية على أداء النمو للأسماك خلال ١٤ أسبوع.

تم استزراع الأسماك فى ١٨ حوض ترابى بمساحة ١٠٠٠ متر مربع للحوض الواحد (٣ أحواض/المعاملة) تم تسميد ٣ المعاملات بزرق الأرانب (الأولى، الثانية والثالثه) بمعدل ٤٠ كجم للحوض أسبوعيا خلال فترة التجربة وتم اختبار الأغذية الإضافية فى الثلاث معاملات الأخرى (الرابعة ، الخامسة، والسادسة) بمعدل ٣% من وزن الجسم يومياً مقسمة على أربعة وجبات.

يمكن تلخيص النتائج المتحصل عليها كما يلى:

١- أثرت المعاملات على الوزن النهائى للأسماك تأثيراً معنوياً خاصة عند استزراع أسماك مبروك الحشائش فى الكثافات الأقل والتى استخدمت فيها الأغذية الإضافية.

٢- أن تغذية البلطى الأوريا على الأغذية الإضافية يزيد الإنتاجية خاصة فى المعاملة السادسة (أعلى كثافة استزراع لمبروك الحشائش) كما أن الوزن النهائى للبلطى الأوريا يزداد فى المعاملات التى تعتمد على الأغذية الإضافية مقارنة بالمعاملات الأخرى المختبرة.

٣- أن زيادة الوزن النهائى للبلطى الاوريا مع زيادة كثافات الاستزراع لمبروك الحشائش ومن الجانب الآخر فإن الوزن النهائى لمبروك الحشائش يقل مع استخدام الأغذية الإضافية خاصة مع الكثافات الأعلى (المعاملة السادسة)، ولكن الإنتاج الكلى يتزايد.

٤- كانت نتائج صفات جودة المياه فى المستوى الأمثل لاستزراع.