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EFFECT OF ORGANIC FERTILIZATION, SUPPLEMENTARY FEEDING AND STOCKING RATE ON GROWTH PERFORMANCE OF NILE TILAPIA AND SILVER CARP

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Abstract

Six ponds (20X50m2) were stocked by 1000 of Nile tilapia fingerlings for each pond. The six ponds were assigned into two groups, each group composed of three ponds, the first pond was stocked with the first stocking rate (SR1) of silver carp (100/pond), the second pond was stocked with the second stocking rate (SR2) of silver carp (200/pond), and the third pond of each group was stocked with the third stocking rate (SR3) of silver carp (300 fish/pond). the three ponds of the first group had the first feeding treatment (fertilization with 50 kg poultry litter every week for each pond) and the three ponds of the second was exposed to the second feeding treatment (fish feed containing 30% crude protein). Results obtained can be summarized as follows:

- Means of body weights of Nile tilapia from the 4^{th} week of the experiment up to the 14^{th} week of the experiment, fed the supplementary feed (containing 30% crude protein) were significantly higher than those fed natural food enhanced by poultry litter as organic fertilization. Body weights of silver carp showed the opposite trend.

- Body weight of Nile tilapia increased with increasing silver carp stocking rate. Increasing silver carp stocking rate as followed by a decrease in body weight of silver carp.

- using supplementary feed increased body length and body depth of Nile tilapia more than the other feeding treatment. The opposite trend was obtained with silver carp.

- Condition factors for Nile tilapia and silver carp were parallelled with previous fish growth results. the effect of stocking rate on condition factor of Nile tilapia and silver carp varied within the whole period of the experiment.

- the values of SGR of Nile tilapia from the first week up to 14^{th} week of the experiment and within biweekly intervals, showed that using supplementary feed gave higher values than using poultry litter in most intervals. The opposite results was obtained with respect to silver carp.

- Increasing stocking rate increased SGR of Nile tilapia, while decreased SGR of silver carp.

The SGR values for tilapia, due to the interaction between feeding treatment and stocking rate, were recorded with fish during the first four weeks as the rates ranged between 3.76 -4.57, while, in the other intervals, the rates had ranged between 0.96 - 2.86. The best SGR values for silver carp were recorded with fish during the first eight weeks (0.37 -1.83), while, in the following weeks, the rates ranged between 0.38 -1.13.

- The total yield for Nile tilapia and silver carp at harvesting, after 14 weeks increased with each increase in stocking rate.

In general the largest fish production (270 kg) for tilapia and silver carp was recorded from the pond provided by the supplementary feed and of the third stocking rate (SR3), and the lowest fish yield was (180 kg) obtained from the pond fertilized with poultry litter of the first stocking rate (SR1).

INTRODUCTION

Polyculture, between tilapia and other aquatic species, is an established option when natural food from different pond niches are independently exploited by fish, when there is a market for all species in culture and when their combination provides an economic benefit which is high enough to cover extra labour expenses required to grade and sort fish at sampling and harvesting.

The aim of this experiment was to test the optimal stocking rate of silver carp which can be stocked with Nile tilapia under the polyculture system of aquaculture, using two types of feeding, natural food enhanced by organic fertilization (poultry litter) and supplemenary feeds (artificial feed).

MATERIALS AND METHODS

The present experiment was conducted during the period from 15 May to 1 September 1995 (14 weeks) in six fresh water earthen ponds each of total area of 0.25 feddan at the Central Laboratory for Aquaculture Research at Abbassa village, Sharkia Governorate, Egypt.

Fish used:

The fish used in this experiment included Nile tilapia (*Oreochromis niloticus*) which is an efficient converter of phytoplankton, but can utilize a wide variety of foods. Ponds were stocked also with silver carp (*Hypophthalmichhthys molitrix*) which feeds primary on phytoplankton. Tilapia fingerlings were obtained from Abbassa hatchery, the average body weight 164 g.

Experimental ponds and stocking rate

Six experimental earthen ponds (1000 m^2, 20 X 50 m) and 130 cm depth supplied with fresh water from Ismaellia canal were used in this investigation. The six ponds were stocked by 1000 of Nile tilapia fingerlings for each pond. The six ponds were assigned into two groups, each group composed of three ponds. The first group was stocked with the first stocking rate (SR1) of silver carp (100 fish/pond), the second pond was stocked with the second stocking rate (SR2) of silver carp (200 fish/pond) and the third pond of each group was stocked with the third stocking rate (SR3) of silver carp (300 fish/pond). The three ponds of the first treatment group had the first feeding treatment (fertilization with poultry litter) and the three ponds of the second treatment group received supplementary feed as described in Table 1.

Table 1. Stocking density of Nile tilapia and silver carp under the two feeding treatments.

Treatment	Stocking Density	Pond No.	Stocking density per pond	Stocking density per feddan
Fertilization	SR 1	1	1000 tilapia + 100 silver carp	4000 tilapia + 400 silver carp
With Poultry	SR 2	2	1000 tilapia + 200 silver carp	4000 tilapia + 800 silver carp
Litter (TI)	SR 3	3	1000 tilapia + 300 silver carp	4000 tilapia + 1200 silver carp
Supplementary	SR 1	4	1000 tilapia + 100 silver carp	4000 tilapia + 400 silver carp
Feed (3% of)	SR 2	5	1000 tilapia + 200 silver carp	4000 tilapia + 800 silver carp
Body weight (T2)	SR 3	6	1000 tilapia + 300 silver carp	4000 tilapia + 1200 silver carp

The three ponds in the first treatment were fertilized with 50 kg poultry litter every week for each pond throughout the experimental period to stimulate the natural foods.

The fish in the three ponds of the second treatment were fed fish using feed containing 30% crude protein. Feed was offered six days per week (except Friday) during the experimental period. The feeding rate was 3% of the total fish mass presented in each pond and the feed amount was adjusted biweekly for each pond separately according to biomass. Chemical analysis of poultry litter and fish feed are presented in Table 2.

Table 2. Chemical analysis of poultry litter and supplementary feed

Item	No. of samples	Poultry litter Mean + SE	Supplementary feed Mean + SE
Moisture %	5	4.23±0.35	9.46±0.35
Crude protein %	5	10.50±0.26	29.77±0.26
Crude fat %	5	1.01±0.08	2.60±0.08
Crude fiber %	5	30.02±0.34	4.40±0.98
Ash %	5	19.15±0.34	9.10±0.34

Fish samples and measurements

Random samples (50 fish from tilapia and 30 fish from silver carp from each pond) were taken biweekly during the experimental period. During this experiment, body measurements (body weight and (in g) body length and body depth (in cm.) were recorded 8 times at biweekly intervals throughout the whole experimental period. The first one was recorded at the time of pond stocking with fish and the last one at harvesting.

Condition factor was determined by using the following formula:

$K = [\text{weight (g)}/\text{length (cm.)}^3] \times 100$

Specific growth rate (SGR) was calculated according to Jauncey and Rose (1982).

Harvesting

At the end of the experiment (1 September 1995) ponds were gradually drained from the water and fish were harvested by seining and transferred to fiberglass tanks and carried to processing center where they were washed, and the fish of the two species (tilapia and silver carp) were sorted and collectively weighed.

Statistical analysis

The statistical analysis of data of the experiment was carried out by applying the computer program, Harvey (1990) by adopting the following fixed model:

$Y_{ijk} = M + T_i + S_j + (TS)_{ij} + e_{ijk}$

Where:

Y_{ijk} = observation of the ijkth fish

M = overall mean

T_i = fixed effect of the ith treatment

S_j = fixed effect of the jth stocking density within the ith treatment

$(TS)_{ij}$ = interaction between the effect of ith treatment and jth stocking density

e_{ijk} = a random error

Differences among means were tested for significance according to Duncan's multiple range test (1995).

RESULTS AND DISCUSSION

Body weight

Tables 3 and 4 show that means of body weights, at experimental start, of each of Nile tilapia and silver carp fed supplementary feed were identical with ones fed the natural food enhanced by organic fertilization (poultry litter). From the 4^{th} week up to 14^{th} week of the experiment, body weights of Nile tilapia fed the supplementary feed were significantly ($P<0.05$) higher than the same species fed the natural food. Silver carp due to the effect of feeding treatment, showed the opposite results. These results may be attributed to the feeding habits of the two species. Tilapia fish is an efficient converter of phytoplankton and can utilize a wide variety of food especially artificial feeds, whereas, silver carp feeds primary on phytoplankton (Bitterlich and Gnaiger, 1984). On the contrary, Reich (1975), reviewed that, in the polyculture system of three species, common carp, silver carp and tilapia, with supplementary feed, the fertilization increased the common carp yield by 35%, silver carp by 31% but had no effect on yield of tilapia fish.

Body weight of tilapia fish grown under the three sliver carp stocking rates at all studied ages revealed that the significant differences, due to stocking rates, started after the first month of raising, but these significant differences were observed after two months for silver carp. As described in Tables 3 and 4, the body weight of Nile tilapia increased with increasing silver carp stocking rate. This result can be attributed to the increasing of the amount of artificial feed which was available for tilapia fish more than silver carp. This result might also be explained on the basis that stocking of Nile tilapia was still below the normal carrying capacity of the pond for tilapia under the condition of spplemental feeding. Also, there was another benefit from the stocking of silver carp with tilapia fish. Reich (1975) showed that, only a small portion of the algae were digested by silver carp and the undigested parts were excreted in the form of small pellets which were available as food for the other species present, carp and tilapia. In this way, silver carp changes natural food, unavailable to other fish, to edible parts. The present results are in agreement with those obtained by MccGinty (1985), who used a constant stocking rate of Nile tilapia with increasing stocking rate of largemouth bass in polyculture system. Fish were fed 32% protein ration, under these experimental conditions he found that, average weight of largemouth bass declined as their stocking density increased, but the average weight and total biomass of originally stocked tilapia increased with increasing largemouth bass stocking density.

Table 4 shows that the increase in the stocking rate of silver carp had negative effect on their average body weight. This result may be attributed to the competition between tilapia and silver carp for the natural food available in the pond. Schroeder (1983) found that 50-70% of the tilapia growth originated with a food chain based photosynthetic natural food, even in the presence of a full ration of protein enriched feed pellets. Snow (1983) stated that, even low stocking rate, density had noticeable effect on the rate of growth. Hafez (1991), found that the increase in mullet stocking rate was followed by a decrease in the body weight of tilapia and carp fish under the polyculture system.

Results presented in Tables 3 and 4 show that variations are significant ($P<0.05$) due to the interaction between feeding treatment and stocking rate, which indicated that these two factors act dependently on each other, and also, each of them had its own significant effect. Schroeder (1979) in this study with polyculture of common carp, silver carp and *Tilapia aurea*, found that fish yield was linearly positively correlated to fish stocking density.

The interaction was more effective with respect to Nile tilapia as its significance began from the 4th week of the experiment and continued significantly up to the 14th week of the experiment, while, the interaction, with respect to silver carp was significantly only in the 10th week of the experiment.

The body weights of Nile tilapia decreased with increasing the stocking density of silver carp in ponds fed the first feeding treatment and the opposite trend was obtained in ponds fed supplementary feed. The body weights of silver carp, at the 10th week of the experiment, decreased with increasing stocking rate of silver carp in both ponds fed the two feeding treatments. The latter result is in agreement with the findings of Yousif (1996) that the negative effect of higher densities on cultured fish species were the reduction of growth rate and lowering of survival rate. Hogendoorn and Koops (1983) showed that, in polyculture of Nile tilapia and African catfish, the biomass increased with increasing stocking rate, but the individual weight was greatly reduced.

Body length and depth

Table 5 and 6 show that supplementary feeding increased body length of Nile tilapia more than the poultry litter. The opposite trend was obtained with silver carp. The significant increase began from the 4th week for tilapia and silver carp. Due to the effect of the 3rd stocking rate, the increase of body length of Nile tilapia was more pronounced compared with the other two densities and the significance among means began early from the 2nd week. With respect to silver carp, the increase was more due to the effect of the 1st stocking rate and the significance began lately from the 8th week of the experiment. Therefore, means of body length of tilapia due to the interaction between the second feeding treatment and the 3rd stocking rate were high compared with other interactions. With respect to silver carp, means of length were high due to the interaction between the first feeding treatment (natural food) and the first stocking rate.

Tables 7 and 8 show that supplementary feeding increased body depth of Nile tilapia more than poultry litter. The opposite trend was obtained with silver carp. The significant increase began from the 6th week for tilapia and from the second week for silver carp. Due to the effect of the 3rd stocking rate, the increase of body depth of Nile tilapia was more compared with the other results, and the significance among means began from the 4th week for tilapia. Results revealed also that the increase in body depth was more pronounced at the highest stocking densities of carp compared with the lower densities where differences in this trait among the groups started to be significant at the 6th week after experimental start. Therefore, means of body length and depth of tilapia due to the interaction between supplementary feeding and the 3rd stocking rate were high due compared with other interactions. In case of silver carp, means of body length and depth were high due to the interaction between natural feeding and the first stocking rate. The present result with tilapia is not in accordance with the findings of Abdel-Wares (1993) who respected that increasing of tilapia stocking rate from 3000 to 6000 fish/feddan was followed by a decrease in body weight, body length and body depth.

The above results are in accordance with results obtained in body weight and specific growth rate of the two fish species used in the present study. Hafez (1991) found a strong correlation between body weight and body length for tilapia, mullet and carp fish.

Condition factor (K)

Condition factor of fish is essentially a measure of relative muscle to bone growth and the differing growth responses of these tissues to diet treatment may be reflected by changes in condition factor (Ostrowski and Garling, 1988). Condition factor was considered to be a sufficient measure of shape, although shape is usually not considered as a character of interest to breeding program, since it has no obvious economic value (Nilsson, 1992).

The estimated condition factor of Nile tilapia in the two feeding treatments (Table 9) show that the most robust fish were in the second treatment (supplementary feeds) at most periods studied of the experiment and condition factor paralleled with previous fish growth results. The differences between the values of condition factor of the feeding treatments, irrespective of stocking density, were significant at all periods except for the two periods at 6 and 10 weeks after the experimental start (Table 10).

For silver carp, Table 10 shows that the most robust fish were in the first treatment (fertilization with poultry litter) and the significant differences between the values of condition factor of the two feeding treatments were observed from 6 weeks of the experiment. The high values of condition factor (K) for Nile tilapia fed the second feeding treatment and the high values of (K) for silver carp fed the first feeding treatment were attributed to the availability of supplementary feed for Nile tilapia in the second feeding treatment and the natural food for silver carp in the first feeding treatment, in adequate quantities . The increase in feeding rate resulted in higher condition factor since the fish grow well when the supply of food was adequate. Similar results, in which condition factors increased with the feeding rate have been reported by Chau and Teng (1982). Dioundick and Stom (1990) demonstrated that, for *O. mossambicus*, the values of condition factors decreased with increasing the -cellulose percent from 0 to 10% of the diet.

Results presented in Table 9, revealed that stocking density, regardless of feeding treatment, has significant effects on condition factor during the whole experimental period for Nile tilapia. The best K values were obtained during the first four weeks after experimental start for the favour of the lowest stocking density, then, continued superiority, by the second stocking rate within the following 4 weeks. Within the rest weeks, best values were given by the 3rd stocking rate.

The effect of stocking rate on condition factor of silver carp was different throughout the whole periods of experiment. The large values were at most of weeks due to the effect of the first stocking rate. The interaction between feed treatment and stocking rate did not show clear tendency, however, its effect was significant ($P<0.05$) in the last weeks of the experiment.

Specific growth rate (SGR)

Averages of SGR of Nile tilapia and silver carp as affected by feeding treatment, stocking rate and the interaction between these two factors are presented in Tables 10 and 12, respectively. In general, the values of SGR of Nile tilapia due to the effect of the two factors were obviously higher than the values of silver carp.

SGR of Nile tilapia from the initial week up to 14th week of the experiment and within biweekly intervals, show that using supplementary feeding gave higher values than using poultry litter in most intervals (Tables 11 and 12). Shiau and Huang (1989), using hybrid tilapia, found that body weight gain was proportional to the protein content of the diet. They added that tilapia fish requires about 24% protein to produce maximum growth when reared in seawater. With respect to SGR of silver carp using the artificial feeding, it gave lower values than using poultry litter. These results may be attributed to the availability of supplementary feeding for tilapia fish and the competition with silver carp for natural food available in the ponds. The micro-herbivorous feeding habits of tilapia allowed the fish to access the naturally occurring micro-flora and fauna of the pond, which may have provided sufficient additional food for tilapia fish. The more rapid growth of the pellet-fed fish also indicates that the pellets may be nutritionally considered as complete food for tilapia fish.

Increasing of stocking rate by silver carp was followed by increasing the amount of supplementary feeding which was more suitable for Nile tilapia in the presence of natural food. Therefore, with increasing stocking rate, SGR of Nile tilapia increased, while, SGR of silver carp decreased. These results are in agreement, partially, with those obtained by Abdel-Wares (1993).

Specific growth rate of tilapia and silver carp, in polyculture system, during the experimental intervals decreased due to the interaction between first treatment (poultry litter) and increasing stocking rates, while due to the interaction between second feeding treatment and increasing stocking rate, SGR of Nile tilapia increased and SGR of silver carp decreased. The best SGR values for tilapia, due to the interaction, were recorded with fish during the first four weeks as the rates ranged between 3.76 - 4.57, while, in the rest weeks, the rates ranged between 0.96 - 2.86. the best SGR values for silver carp, due to the interaction, were recorded with fish during the first eight weeks as the rates ranged between 0.37 -1.83, while, in the rest weeks, the rates ranged between 0.38 - 1.13.

Total yield

Averages of total yield at the end of the experimental were presented in Table 13. Tilapia gained the highest yield (462 kg) when fed the supplementary feed compared with 324 kg gained by the same fish raised in the first feeding treatment (poultry litter).

Averages of the total yield for Nile tilapia fed the first feeding treatment, calculated as percentage of the largest yield (T2) were found to be 70.13%. The opposite results were obtained with silver carp, as the first treatment gained (291 kg) compared with 206 kg (70.80%) for the second treatment. These results may be attributed to the feeding habits of the two species as described previously. The total fish production (tilapia fish + silver carp) for the first feeding treatment (organic fertilization) was 92.1% of the total fish production for second feeding treatment (supplementary feeds), and this differences may be due to the high production from tilapia which grew better in the second treatment. These are in partial in agreement with those obtained by Collis and Smitherman (1978). They found that, hybrid tilapia when fed on manure, grew 62% compared to hybrids fed on a high protein diet. Barash and Schroeder (1984) found that the substitution of 46% of the pellets by fermented cow manure did not reduce the total fish yield, but the complete substitution of the pellets by fermented cow manure caused a 47% decrease in the total yield.

The results presented in Table 13 indicated that, the total yield for Nile tilapia and silver carp at harvesting as affected by stocking rate regardless of feeding treatment (at the 14^{th} week of the experiment), increased with each increase in stocking rate.

The interaction between type of feeding and stocking rate was found to be significant. This may indicate that for tilapia fish under the manuring system, the total yield of tilapia decreased with each increase in the stocking rate of silver carp. These findings may be due to the fact that under this manuring system and interspecies competition on natural food occurred and this is reflected negatively on total yield of tilapia. This phenomena disappeared in the second treatment receiving artificial complete diet where tilapia yield increased with each increase in stocking rate of silver carp.Thus, the competition on food was reduced and more natural food was available for silver carp. On the other hand results revealed that average body weight of silver carp decreased with increasing stocking rate, however, the total yield increased because of the fact that the number of culture carp was higher at higher densities.

Regarding the total fish yield from all experimental ponds, the pond of the second feeding treatment (artificial feed) and the third stocking rate produced the highest yield of tilapia fish (180 kg), while, the pond of the first feeding treatment and the third stocking rate produced the smallest yield (96 kg). For silver carp the largest yield was obtained from the pond received the first feeding treatment and the third stocking rate (132 kg) but the smallest yield was recorded from the pond received the artificial feed and the first stocking rate (47 kg). In general, the total fish production (Nile tilapia + silver carp) was recorded from the pond of the second feeding treatment and the third stocking rate (270 kg). The lowest production was obtained from the pond fertilized with poultry litter and had the first stocking rate (180 kg). These results show that, using poultry litter as an organic fertilizer produced lower total yield for tilapia than using the supplementary feed, but where manure is available at a nominal cost it is preferable to use it as the net returns would be profitable compared with artificial feed alone. On the other hand, silver carp had the largest yields under the organic fertilization with poultry litter compared with the supplementary feed. The choice of the optimal stocking rate from the two species and feeding type depends economically on the costs of feeding and the price of the two fish species.

Table 5. Least-square means and standard error of the tested factors affecting body length (cm.) of Nile tilapia.

Independent variable	No.	initial Mean±SE	2-weeks Mean±SE	4-weeks Mean±SE	6-weeks Mean±SE	8-weeks Mean±SE	10-weeks Mean±SE	12-weeks Mean±SE	14-weeks Mean±SE
Feeding treatment (T)		ns	ns	* *	* * *	* * *	* * *	* * *	* * *
T1 (poultry litter)	150	8.1±0.1a	9.9±0.1a	12.6±0.1b	13.9±0.1b	15.1±0.1b	16.0±0.1b	17.2±0.1b	17.9±0.1b
T2 (artificial feed)	150	8.1±0.1a	10.8±0.1a	13.0±0.1a	14.7±0.1a	16.0±0.1a	17.4±0.1a	18.3±0.1a	19.7±0.1a
Stocking rate (SR)		ns	* * *	* * *	* *	* *	*	* * *	* *
SR1 (1000 tilapia ± 100 S.carp)	100	8.1±0.2a	9.5±0.1b	12.0±0.2b	14.5±0.2a	15.3±0.1b	16.5±0.1b	17.3±0.1c	18.4±0.2b
SR2 (1000 tilapia ± 200 S.carp)	100	8.1±0.2a	10.2±0.1a	13.0±0.2a	13.9±0.2b	15.5±0.1b	16.8±0.1a	17.7±0.1b	18.8±0.2ab
SR3 (1000 tilapia ± 300 S.carp)	100	8.2±0.2a	10.4±0.1a	13.4±0.2a	14.4±0.2a	15.9±0.1a	16.9±0.1a	18.3±0.1a	19.1±0.2a
T x SR		ns	ns	* * *	* * *	* * *	* * *	* * *	* * *
T1 x SR1	50	8.1±0.2a	9.4±0.2c	12.4±0.2c	14.6±0.2b	15.4±0.2c	16.3±0.1c	17.5±0.2c	18.2±0.2c
T1 x SR2	50	8.1±0.2a	10.1±0.2ab	12.6±0.2c	13.5±0.2c	15.8±0.2d	15.9±0.1d	17.2±0.2c	17.9±0.2cd
T1 x SR3	50	8.2±0.2a	10.3±0.2a	12.8±0.2c	13.6±0.2c	15.0±0.2cd	15.9±0.1d	17.0±0.2c	17.4±0.2d
T2 x SR1	50	8.1±0.2a	9.7±0.2bc	11.7±0.2b	14.4±0.2b	15.2±0.2cd	16.7±0.1b	17.2±0.2c	18.5±0.2c
T2 x SR2	50	8.1±0.2a	10.6±0.2a	13.5±0.2a	14.4±0.2b	16.2±0.2b	17.7±0.1a	18.2±0.2b	19.6±0.2b
T2 x SR3	50	8.1±0.2a	10.5±0.2a	14.0±0.2a	15.2±0.2a	16.8±0.2a	17.9±0.1a	19.6±0.2a	20.9±0.2a
Overall mean	300	8.1±0.1	10.1±0.1	12.8±0.1	14.3±0.2	15.6±0.1	16.7±0.1	17.8±0.1	18.8±0.1

Table 6. Least-square means and standard error of the tested factors affecting body length (cm.) of silver carp.

Independent variable.	No.	initial Mean±SE	2-weeks Mean±SE	4-weeks Mean±SE	6-weeks Mean±SE	8-weeks Mean±SE	10-weeks Mean±SE	12-weeks Mean±SE	14-weeks Mean±SE
Feeding treatment (T)		ns	ns	* *	* * *	* * *	* * *	* * *	* * *
T1 (poultry litter)	90	25.33±0.30a	25.64±0.37a	27.73±0.37a	30.56±0.36a	32.14±0.33a	33.56±0.29a	33.58±0.24a	35.66±0.24a
T2 (artificial feed)	90	25.33±0.30a	25.17±0.37a	26.16±0.37b	27.79±0.37b	29.72±0.33b	30.47±0.29b	31.48±0.24b	32.63±0.24b
Stocking rate (SR)		ns	ns	ns	ns	*	* * *	* * *	* * *
SR1 (1000 tilapia ± 100 S.carp)	60	25.32±0.36a	25.07±0.46a	27.23±0.46a	29.27±0.45a	31.82±0.40a	33.30±0.35a	34.43±0.30a	36.60±0.29a
SR2 (1000 tilapia ± 200 S.carp)	60	25.37±0.36a	25.27±0.46a	26.53±0.46a	29.47±0.45a	30.80±0.40ab	31.77±0.35b	31.88±0.30b	33.95±0.29b
SR3 (1000 tilapia ± 300 S.carp)	60	25.32±0.36a	25.88±0.46a	27.07±0.46a	28.78±0.45a	30.18±0.40b	30.97±0.35b	31.42±0.30b	31.88±0.29c
T x SR		ns	ns	ns	ns	*	ns	* *	*
T1 x SR1	30	25.30±0.50a	25.33±0.64a	27.67±0.65ab	29.93±0.63a	32.90±0.57a	34.33±0.50a	34.60±0.42a	37.80±0.41a
T1 x SR2	30	25.37±0.50a	25.20±0.64a	27.27±0.65ab	31.60±0.63a	31.27±0.57abc	33.53±0.50ab	33.07±0.42b	35.10±0.41bc
T1 x SR3	30	25.33±0.50a	25.40±0.64a	28.27±0.65a	30.31±0.63ab	32.27±0.57ab	32.80±0.50b	32.37±0.42b	34.07±0.41c
T2 x SR1	30	25.33±0.50a	25.80±0.64a	26.80±0.65ab	28.60±0.63bc	30.73±0.57bc	32.26±0.50b	34.27±0.42ab	35.40±0.41b
T2 x SR2	30	25.37±0.50a	25.33±0.64a	25.80±0.65b	27.33±0.63c	30.33±0.57c	30.00±0.50c	30.720±0.42c	32.80±0.41d
T2 x SR3	30	25.30±0.50a	25.37±0.64a	25.87±0.65b	27.43±0.63c	28.10±0.57d	29.13±0.50c	29.47±0.42d	29.70±0.41c
Overall mean	180	25.33±0.21	25.41±0.26	26.94±0.27	29.17±0.26	30.93±0.23	32.01±0.20	32.58±0.	34.14±0.17

+ Means with the same letter in each column are not significantly different. *P<0.05 **P<0.01 ***P<0.001

Table 9. Least-square means and standard error of the tested factors affecting condition factor (K) of Nile tilapia.

Independent variable	No.	initial Mean±SE	2-weeks Mean±SE	4-weeks Mean±SE	6-weeks Mean±SE	8-weeks Mean±SE	10-weeks Mean±SE	12-weeks Mean±SE	14-weeks Mean±SE
Feeding treatment (T)		ns	* * *	* * *	ns	*	ns	* * *	*
T1 (poultry litter)	150	1.86±0.03a	2.10±0.05a	1.70±0.06b	1.83±0.02a	1.76±0.02b	1.76±0.01a	1.71±0.03b	1.85±0.02b
T2 (artificial feed)	150	1.88±0.03a	1.86±0.05b	2.01±0.06a	1.82±0.02a	1.82±0.02a	1.77±0.01a	1.93±0.03a	1.90±2.02a
Stocking rate (SR)		ns	* * *	* * *	* * *	*	*	* *	ns
SR1 (1000 tilapia ± 100 S.carp)	100	1.88±0.04a	2.29±0.06a	2.20±0.07a	1.71±0.03c	1.81±0.02a	1.73±0.02a	1.83±0.03a	1.86±0.02a
SR2 (1000 tilapia ± 200 S.carp)	100	1.89±0.04a	1.90±0.06b	1.73±0.07b	1.94±0.03a	1.81±0.02a	1.76±0.02ab	1.88±0.03a	1.87±0.02a
SR3 (1000 tilapia ± 300 S.carp)	100	1.83±0.04a	1.75±0.06b	1.65±0.07b	1.82±0.03b	1.75±0.02b	1.80±0.02a	1.74±0.03b	1.89±0.02a
T x SR		ns	* * *	ns	ns	* *	* * *	* *	* * *
T1 x SR1	50	1.88±0.05a	2.63±0.09a	1.92±0.10b	1.75±0.04cd	1.79±0.03a	1.80±0.03b	1.79±0.05bc	1.91±0.03ab
T1 x SR2	50	1.88±0.05a	1.97±0.09b	1.63±0.10c	1.93±0.04ab	1.82±0.03a	1.79±0.03b	1.70±0.05cd	1.81±0.03c
T1 x SR3	50	1.81±0.05a	1.70±0.09b	1.56±0.10c	1.80±0.04c	1.67±0.03b	1.68±0.03c	1.63±0.05d	1.84±0.03bc
T2 x SR1	50	1.88±0.05a	1.95±0.09b	2.48±0.10a	1.67±0.04d	1.82±0.03a	1.67±0.03c	1.87±0.05b	1.81±0.03c
T2 x SR2	50	1.81±0.05a	1.84±0.09b	1.82±0.10bc	1.96±0.04a	1.81±0.03a	1.73±0.03bc	2.06±0.05a	1.94±0.03a
T2 x SR3	50	1.85±0.05a	1.79±0.09b	1.74±0.10bc	1.83±0.04bc	1.82±0.03a	1.92±0.03a	1.85±0.05b	1.95±0.03a
Overall mean	300	1.87±0.02	1.98±0.04	1.86±0.04	1.82±0.02	1.79±0.01	1.77±0.01	1.82±0.02	1.87±0.01

Table 10. Least-square means and standard error of the tested factors affecting body condition factor (K) of silver carp.

Independent variable	No.	initial Mean±SE	2-weeks Mean±SE	4-weeks Mean±SE	6-weeks Mean±SE	8-weeks Mean±SE	10-weeks Mean±SE	12-weeks Mean±SE	14-weeks Mean±SE
Feeding treatment (T)		ns	ns	ns	**	*	**	***	***
T1 (poultry litter)	90	0.99±0.01a	1.11±0.02a	1.07±0.01a	1.03±0.02b	1.05±0.02a	1.12±0.02a	1.20±0.01a	1.11±0.01a
T2 (artificial feed)	90	0.99±0.01a	1.06±0.02a	1.08±0.01a	1.09±0.02a	1.00±0.02b	1.04±0.02b	1.07±0.01b	1.04±0.01b
Stocking rate (SR)		ns	***	**	***	**	**	**	***
SR1 (1000 tilapia ± 100 S.carp)	60	0.99±0.02a	1.14±0.02a	1.07±0.02b	1.16±0.02a	1.08±0.02a	1.15±0.02a	1.15±0.01a	1.05±0.01b
SR2 (1000 tilapia ± 200 S.carp)	60	0.99±0.02a	1.11±0.02a	1.12±0.02a	0.97±0.02a	0.98±0.02b	1.05±0.02b	1.16±0.01a	1.06±0.01b
SR3 (1000 tilapia ± 300 S.carp)	60	0.99±0.02a	1.01±0.02b	1.04±0.02b	1.06±0.02b	1.03±0.02ab	1.05±0.02b	1.10±0.01b	1.12±0.01a
T x SR		ns	ns	**	*	***	ns	***	***
T1 x SR1	30	0.99±0.02a	1.17±0.03a	1.07±0.03ab	1.10±0.03b	1.06±0.03a	1.22±0.03a	1.26±0.02a	1.08±0.02a
T1 x SR2	30	0.98±0.02a	1.13±0.03a	1.15±0.03a	0.90±0.03c	1.08±0.03a	1.06±0.03b	1.21±0.02a	1.13±0.02a
T1 x SR3	30	0.99±0.02a	1.03±0.03bc	0.98±0.03c	1.08±0.03b	1.02±0.03a	1.08±0.03b	1.12±0.02b	1.12±0.02a
T2 x SR1	30	0.99±0.02a	1.11±0.03ab	1.06±0.03	1.21±0.03a	1.10±0.03a	1.08±0.03b	1.04±0.02c	1.01±0.02b
T2 x SR2	30	0.99±0.02a	1.08±0.03abc	1.09±0.03ab	1.04±0.03b	0.88±0.03b	1.03±0.03b	1.10±0.02b	0.98±0.02b
T2 x SR3	30	0.99±0.02a	1.00±0.03c	1.09±0.03ab	1.03±0.03b	1.04±0.03a	1.01±0.03b	1.08±0.0cbc	1.13±0.02a
Overall mean	180	0.99±0.01	1.09±0.01	1.07±0.01	1.06±0.01	1.03±0.01	1.09±0.01	1.13±0.01	1.08±0.01

+ Means with the same letter in each column are not significantly different. *P<0.05 **P<0.01 ***P<0.001

Table 11. Specific growth rate (SGR) of Nile tilapia during the experimental periods as affected by feeding type and silver carp stocking rate.

Independent variable	0-2 weeks	2-4 weeks	4-6 weeks	6-8 weeks	8-10 weeks	10-12 weeks	12-14 weeks	Average of total period
Feeding treatment (T)								
T1 (poultry litter)	3.84	3.5	2.44	1.35	1.13	1.39	1.27	2.13
T2 (artificial feed)	4.07	4.92	2.02	1.68	1.53	1.35	1.59	2.45
Stocking rate (SR)								
SR1 (1000 tilapia ± 100 S.carp)	3.76	4.04	2.51	1.35	1.24	1.36	1.26	2.22
SR2 (1000 tilapia ± 200 S.carp)	4.23	4.17	1.97	1.59	1.36	1.31	1.55	2.31
SR3 (1000 tilapia ± 300 S.carp)	3.91	4.57	2.17	1.65	1.44	1.42	1.54	2.38
T x SR								
T1 x SR1	3.97	3.70	2.86	1.13	0.96	1.61	1.25	2.22
T1 x SR2	4.00	3.38	2.12	1.53	1.23	1.28	2.29	2.12
T1 x SR3	3.56	3.48	2.26	1.43	1.22	1.25	1.28	2.07
T2 x SR1	3.55	4.41	2.13	1.58	1.53	1.09	1.28	2.22
T2 x SR2	4.41	4.80	1.86	1.63	1.46	1.33	1.75	2.46
T2 x SR3	4.26	5.42	2.09	1.80	1.58	1.52	1.68	2.63

Table 12. Specific growth rate (SGR) of Silver carp during the experimental periods as affected by feeding type and silver carp stocking rate.

Independent variable	0-2 weeks	2-4 weeks	4-6 weeks	6-8 weeks	8-10 weeks	10-12 weeks	12-14 weeks	Average of total period
Feeding treatment (T)								
T1 (poultry litter)	1.15	1.20	1.70	1.30	0.91	0.63	0.62	1.07
T2 (artificial feed)	0.53	0.89	1.09	0.86	0.90	0.66	0.53	0.78
Stocking rate (SR)								
SR1 (1000 tilapia ± 100 S.carp)	0.91	1.15	1.72	1.44	1.09	0.76	0.66	1.11
SR2 (1000 tilapia ± 200 S.carp)	0.79	1.00	1.28	1.06	0.90	0.61	0.63	0.90
SR3 (1000 tilapia ± 300 S.carp)	0.83	1.00	1.25	0.76	0.68	0.52	0.42	0.78
T x SR								
T1 x SR1	1.07	1.18	1.83	1.75	1.13	0.74	0.77	1.21
T1 x SR2	1.19	1.22	1.62	1.13	0.84	0.62	0.66	1.04
T1 x SR3	1.20	1.19	1.66	0.99	0.72	0.50	0.38	0.95
T2 x SR1	0.75	1.12	1.61	1.08	1.05	0.78	0.53	0.99
T2 x SR2	0.37	0.74	0.85	0.98	0.98	0.58	0.59	0.73
T2 x SR3	0.45	0.79	0.72	0.43	0.62	0.55	0.47	0.58

Table 13 .Total yield of Nile tilapia and silver carp as affected by feeding type and silver carp stocking rate.

Independent variable	Nile tilapia		Silver crap		Total	
	Yield (kg)	%	Yield (kg)	%	Yield (kg)	%
Feeding treatment (T)						
T1 (poultry litter)	324	70.1%	291	100%	615	92.1%
T2 (artificial feed)	462	100%	206	70.8%	688	100%
Stocking rate (SR)						
SR1 (1000 tilapia ± 100 S.carp)	241	87.3%	107	48.2%	348	69.9%
SR2 (1000 tilapia ± 200 S.carp)	269	97.5%	168	75.7%	437	87.8%
SR3 (1000 tilapia ± 300 S.carp)	276	100%	222	100%	498	100%
T x SR						
T1 x SR1	120	66.7%	60	45.5%	180	66.7%
T1 x SR2	108	60.0%	99	75.0%	207	76.7%
T1 x SR3	96	53.3%	132	100%	228	84.4%
T2 x SR1	121	67.2%	47	35.6%	168	62.2%
T2 x SR2	161	89.4%	69	52.3%	230	85.2%
T2 x SR3	180	100%	90	68.2%	270	100%

* Total yield of 3 ponds ** Total yield of 3 ponds.

REFERENCES

1. Abdel-Wares, A.A. 1993. Studies on growth and development of Tilapia nilotica as affected by Different environmental factors. M.Sc. Thesis, Fac. Agric., Al-Azhar Univ., Egypt.

2. Barash, H. and G.L. Schroeder 1984. Use of fermented cow manure as a feed substrate for fish polyculture in Stagant water ponds. Aquaculture, 36:127-140.

3. Bitterlich, G. and E. Gnaiger 1984. Phytoplanktivourous or omnivorous fish. Digestibility of zooplankton by silver carp, Hypophthalmichthys molitrix (val). Aquaculture, 40:261-263...

4. Chua, T.E. and S.K. Teng. 1982. Effects of food ration on growth, condition factor, food conversion efficiency, and net yield of estuary grouper, Epinephelus salmonides Maxwell, cultured in floating Net-cages. Aquaculture, 27:273-283.

5. Collis, W.J. and R.O. Smitherman. 1978. Production of tilapia hybrids with cattle manure of a commercial diet. pp 43-54. In R.O. Smitherman, W.L. Shelton and J.H. Grover (editors). Culture of exotic fishes symposium proceedings. Fish culture section, American Fisheries Society, Auburn, Alabama. USA

6. Dioundick, O.B. and D.I. Stom. 1990. Effects of dietary & -cellulose levels on the juvenile tilapia, Oreochromis niloticus (peters). Aquaculture, 91:311-315.

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

8. Hafez, A.F. 1991. Studies on some productive traits in fish. Thesis, Ph.D. Fac. Agric., Moshhtohor, Zagazig Univ. (Banha branch), Egypt.

9. Harvey, W.R. 1990. User's guide for LSMLMW. Mixed model least-squares and maximum likelihood computer program. Ohio state University, Columbus, USA.

10. Hoggendoorn, H. and W.J. Koops. 1983. Growth and production of African catfish, Clarias lazera, 1. Effects of stocking density, pond size and mixed culture extensive field conditions. Aquaculture, 34:253-263.

11. Jauncey, K. and B. Rose 1982. A guide to tilapia feeds and feeding, Institute of Aquaculture, University of Sterling, Scotland.

12. McGinty, A.S. 1985. Effect of predation by largemouth bass in fish production ponds stocked with Tilapia nilotica. Aquaculture, 96: 119-138.

13. Nilson, J. 1992. Genetic parameters of growth and sexual maturity in Arctic char (Salvelinus alpinus). Aquaculture, 106:9-19.

14. Ostrowski, A.C. and D.L. Garling. 1988. Influences of anabolic hormone treatment and dietary protein: energy ratio on condition and muscle deposition of rainbow trout. Prog. Fish-cult., 50: 133-140.

15. Reich, K. 1975. Multispecies fish culture (polyculture) in Israel. Bamidgeh, 27: 85-99.

16. Schroeder, G.L. 1979. Microorganisms as the primary diet in fish farming. World symposium on finfish nutrition and fish fed technology, Hamburg (GFR), 20 jun.

17. Schroeder, G.L. 1983. The role of natural foods in tilapia growth. A study based on Stable isotope analysis. Fishelson and Z. Yaron (Editors), Intern. sym. on tilapia in aquaculture, Proc., PP. 313-322, Nazareth, Israel.

18. Shiau, S.Y. and Huang, S.L. 1989. Optimal dietary levels for hybrid tilapia (Oreochromis niloticus X O. aureus) reared in seawater. Aquaculture, 81: 119-127.

19. Snow, J.R. 1983. Size control of catfish fingerlings by varing the stocking density. Intern. prog., Auburn, Alabama, USA.

20. Yousif, O.M. 1996. Effects of rearing conditions in closed recirculating systems on growth, feed utilization, Carcass composition and nutrient digestibility of juvenile tilapia (Oreochromis niloticus L). Thesis, Institute of Animal Physiology and Animal Nutrition. University of Gottingen, Germany.

تأثير التسميد العضوي، الأعلاف الاضافية وكذلك معدل الكثافة على مكونات صفات النمو للبلطي النيلي والمبروك الفضي

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اجريت هذه التجربة في الفترة من ١٥ مايو الى ١ سبتمبر عام ١٩٩٥ . وذلك باستخدام ستة أحواض ترابية بالمعمل المركزي لبحوث الاسماك بالعباسة، مركز ابو حماد، محافظة الشرقية. وقد استهدفت هذه التجربة دراسة تأثير استزراع كثافات مختلفة من اسماك المبروك الفضي مع اسماك البلطي النيلي تحت نظام التربية المختلطة لأنواع الاسماك. هذا بالاضافة الى دراسة تأثير تسميد عضوي باستخدام فرشة الدجاج ودراسة تأثير ذلك على صفات النمو لأسماك البلطي والمبروك الفضي.

وعند بداية التجربة وضعت ١٠٠٠ سمكة من أصبعيات البلطي (١١,٣ جرام) في كل حوض. ثم قسمت هذه الاحواض الى مجموعتين تحتوي كل مجموعة على ثلاثة احواض ثم وضعت ١٠٠ سمكة في الحوض الاول، ٢٠٠ سمكة في الحوض الثاني، ٣٠٠ سمكة في الحوض الثالث. هذا وسمدت الاحواض الثلاثة المكونة للمجموعة الاولى باستخدام فرشة الدجاج بواقع ٥٠ كجم اسبوعيا طوال فترة التجربة وذلك بهدف تنمية الغذاء الطبيعي الميسر في هذه الاحواض. اما الاحواض الثلاثة المكونة للمجموعة الثانية فقد غذيت باستخدام اعلاف الاسماك المصنعة والمحتوية على ٣٠٪ بروتين خام وذلك بمعدل ٣٪ من وزن الاسماك الموجودة في كل حوض يوميا (٦ ايام اسبوعيا) ومن اهم النتائج المتحصل عليها ما يلي:

١- لقد اظهرت النتائج أن وزن الجسم لأسماك البلطي النيلي والتي غذيت على علف الاسماك المصنعة (٣٠٪ بروتين خام) كانت اكبر من تلك التي غذيت على الغذاء الناتج من التسميد العضوي بفرشة الدجاج. وذلك من الاسبوع الرابع وحتى نهاية التجربة. اما اسماك المبروك الفضي فقد اظهرت عكس هذه النتائج.

٢- ان اوزان اسماك البلطي النيلي قد زادت بزيادة كثافة المبروك الفضي التي اضيفت الى احواض تربية البلطي. وكان ذلك مصحوبا بتناقص في وزن اسماك المبروك الفضي. وهذا بالطبع راجع الى التنافس بين البلطي والمبروك الفضي على الغذاء الطبيعي المتاح في احواض التربية.

٣- ان هناك تأثيرا تفاعليا مشتركا بين نوع الغذاء وكثافة اسماك المبروك الفضي على وزن الجسم هذا بالاضافة الى تأثير كل عامل منفرد على وزن الجسم.

٤- كانت اطوال واعماق اجسام اسماك البلطي التي غذيت على اعلاف الاسماك الاضافية المصنعة اكبر من تلك التي غذيت على الغذاء الطبيعي فقط. بينما اعطت اسماك المبروك الفضي نتائج عكسية. وقد ظهرت هذه الفروق بداية من الاسبوع الثاني من التجربة بالنسبة لطول الجسم