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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 (20×50 m^2) were stocked by 1000 of Nile tilapia fingerlings for each pond. The six ponds assigned into two groups, each group composed of three ponds, the first pond stocked with the first stocking rate (SR1) of silver carp (100 fish/pond), the second pond stocked with the second stocking rate (SR2) of silver carp (200 fish/feddan) and the third pond of each group 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 group had the second feeding treatment (fish feed containing 30% crude protein). Results obtained can be summarize as follows:

- Means of body weights of Nile tilapia from the 4th week up to the 14th week of the experiment, fed the supplementary feed (containing 30% crude protein) were significantly higher than the same specie fed natural food enhanced by poultry litter as organic fertilization. Body weights of silver carp showed the opposite results.
- Body weight of Nile tilapia increased with increasing silver carp stocking rate. Increasing silver carp stocking rate was followed by 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 paralleled with previous fish growth results. The effect of stocking rate on condition factor of Nile tilapia and silver carp are different within the whole period of the experiment.
- The values of SGR of Nile tilapia from the first week up to 14th week of the experiment and within biweekly intervals, show that, using supplementary feed gave higher values than using poultry litter in most intervals. The opposite results was obtained with respect to silver carp.
- The increasing stocking rate, SGR of Nile tilapia increased, while SGR of silver carp decreased.
- The best 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 rest weeks the rates 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 rest 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 had the supplementary feed and the third stocking rate (SR3), and the lowest fish yield (180 kg) obtained from the pond fertilized with poultry litter and had 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 find the optimal stocking rate of silver carp can be stocked with Nile tilapia under the polyculture system of aquaculture, using two types of feeding, natural food which enhanced by organic fertilization (poultry litter) and supplementary feeds (artificial feed).

MATERIALS AND METHODS

The present experiment was conducted during the period between 15 may and 1 September 1995 (14 weeks) in six fresh water earthen ponds each of a 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 p****hytoplankton but can utilize a wide variety of foods. Ponds were stocked also with silver carp (*Hypophthalmichthys molitrix)* which feeds primary on phytoplankton. Tilapia fingerlings were obtained from Abbassa hatchery, the average weight of fingerlings was 11.3 gm. Silver carp were obtained from the production ponds in Abbassa farm and where their average body weight of silver carp was 164 gm.

Experimental ponds and stocking rate

Six experimental earthen ponds (1000 m^2 , 20×50 m) and 130 cm depth are supplied with fresh water from Ismaellia canal. The six ponds were stocked by 1000 of Nile tilapia fingerlings for each pond. Then the six ponds assigned into two groups, each group composed of three ponds, the first stocked with the first stocking rate (SR1) of silver carp (100 fish/pond), the second pond stocked with the second stocking rate (SR2) of silver carp (200 fish/pond) and the third pond of each group 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 with Poultry litter (T1)	SR1	1	1000 tilapia+100 silver carp	4000 tilapia+400 silver carp
	SR2	2	1000 tilapia+200 silver carp	4000 tilapia+800 silver carp
	SR3	3	1000 tilapia+300 silver carp	4000 tilapia+1200 silver carp
Supplementary Feed (3% of body Weight) T2	SR1	4	1000 tilapia+100 silver carp	4000 tilapia+400 silver carp
	SR2	5	1000 tilapia+200 silver carp	4000 tilapia+800 silver carp
	SR3	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 the 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 fibre%	5	30.02±0.98	5.40±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, (in gm) body length and body depth in cm) were recorded 8 times on at biweekly interval throughout the whole experiment period. The first one recorded at the time of pond stocking with fish and the last one at harvesting.

Condition factor was determined by using the following formula:

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

specific growth rate 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 the processing centre where they washed, and the fish of the two species (tilapia and scarp) were sorted and collectively weighed.

Statistical analysis

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

$$\mathbf{Y_{ijk} = \mu + T_i + S_j + (TS)_{ij} + e_{ijk}}$$

where:

Y_{ijk} = observation of the ijk-th fish; μ = overall mean; T_i = fixed effect of the i-th treatment; S_j = fixed effect of the j-th stocking density within the i-th treatment. $TS)_{ij}$ = interaction between the effect of i-th treatment and j-th stocking density and e_{ijk} = a random error.

Differences among means were tested for significance according to Duncan's multiple range test (1955).

RESULTS AND DISCUSION

Body weight

Tables 3 and 4 show that means of body weights, at the initial weeks, 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 the 14^{th} week of the experiment, body weights of Nile tilapia fed the supplementary feed were significantly higher than the same specie 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 as tilapia fish which is an efficient converter of phytoplankton and can utilize a wide varity of food especially artificial feeds, while silver carp feeds primary on phytoplankton (Bitterlich and Gnaiger, 1984). In 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 the yield of tilapia fish.

Body weight of tilapia fish grown under the three silver carp stocking rates at all studied ages revealed that the significant differences, due to stocking rate, started after the first month of raising but these significant differences 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 results 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 supplemented feeding. Also there was another benefit from the stocking of silver carp with tilapia fish, explained by Reich (1975) who 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 that obtained by McGinty (1985), who used a constant stocking rate of Nile tilapia with increasing stocking rate of largemouth bass in a 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 a 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 ($P<0.001$) 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 his 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 it′s significance began from the 4^{th} week of the experiment and continued significantly up to the 14^{th} week of the experiment while the interaction, with respect to silver carp was significant only in the 10^{th} 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 10^{th} 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

Tables 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 significance increase began from the 4^{th} week for tilapia and silver carp. Due to the effect of the 3^{rd} 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 2^{nd} week. While with respect to silver carp, the increase was more due to the effect of the 1^{st} stocking rate and the significance began lately from the 8^{th} week of the experiment. Therefore, means of body length of tilapia due to the interaction between the second feeding treatment and the 3^{rd} stocking rate were high compared with other interactions. But 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 significance increase began from the 6^{th} week for tilapia and from the second week for silver carp. Due to the effect of the 3^{rd} stocking rate, the increase of body depth of Nile tilapia was more compared with the other rates and the significance among means began from the 4^{th} 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 compared with other interactions. But 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 reported that increasing of tilapia stocking rate from 3000 to 6000 fish\feddan followed by a decrease in body weight, body length and 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 programmes, 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 factors paralleled with previous fish growth results. The differences between the values of condition factor of the two 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 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 and the increase in feeding rate resulted in higher condition factor since the fish grow well when the supply of food is 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. massambicus,* the values of condition factors decreased with increasing the $\propto$-cellulose percent from 0 to 10% of the diet.

Results presented in table (9), revealed that stocking density, regardless of feeding treatment, released significant effects on condition factor during the whole experiment periods 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 affected by the 3rd stocking rate.

The effect of stocking rate on condition factor of silver carp was different throughout the whole period 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 ($P<0.01$) 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. As previously mentioned in case of body weights 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 crap 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 experiment were listed in table (13). As described in this 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 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 the second feeding treatment (supplementary feeds) and this difference may be due to the high production from tilapia which grew better in the second treatment. These results are in partial agreement with that 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 listed 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 due to the fact that under this manuring system an 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 increase 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, whoever the total yield increase because of the fact that the number of culture carp was higher at higher densities.

Total fish yield from all experimental ponds, the pond had the second feeding treatment (artificial feed) and the third stocking rate produced the highest yield of tilapia fish (180 kg) while the pond had the first feeding treatment and the third stocking rate produced the smallest yield (96 kg). For silver carp the largest yield obtained from the pond received the first feeding treatment and the third stocking rate (132 kg) but the smallest yield 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 which had the second feeding treatment and the third stocking rate (270 kg). The lowest production 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 produce 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 fetrtilization with poultry litter compared with the supplementary feed. The choice of the optimal stoking rate from the two species and feeding type depend economically on the costs of feeding and the price of the two fish species.

Table (3): Least-square means and standard error of the tested factors affecting on body weight (gm) 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	11.3±0.6 a	20.1±0.7 a	34.0±0.8 b	49.0±1.2 b	60.0±1.1 b	71.1±1.2 b	87.6±1.3 b	106.0±3.5 b
T2 (artificial feed)	150	11.3±0.6 a	20.8±0.7 a	43.5±0.8 a	58.9±1.2 a	75.8±1.1 a	95.3±1.2 a	116.6±1.3 a	148.1±3.5 a
Stocking rate (SR)		Ns	ns	**	ns	***	***	***	***
SR1 (1000 tilapia + 100 S.carp)	100	11.2±0.8 a	19.7±0.8 a	36.1±1.0 b	52.6±1.5 a	64.4±1.4 b	77.6±1.5 c	95.1±1.6 c	114.9±4.3 b
SR2 (1000 tilapia + 200 S.carp)	100	11.3±0.8 a	21.3±0.8 a	39.8±1.0 a	53.5±1.5 a	67.9±1.4ab	83.3±1.5 b	101.4±1.6 b	128.0±4.3 a
SR3 (1000 tilapia + 300 S.carp)	100	11.3±0.8 a	20.3±0.8 a	40.3±1.0 a	55.8±1.5 a	71.5±1.4 a	88.7±1.5 a	109.7±1.6 a	138.2±4.3 a
T × SR		Ns	ns	***	***	***	***	***	***
T1×SR1	50	11.3±1.1 a	20.5±1.1 a	35.7±1.5 b	54.8±2.1bc	64.9±1.9 c	74.9±2.1cd	95.4±2.2 c	115.1±6.1 c
T1×SR2	50	11.3±1.1 a	20.6±1.1 a	34.2±1.5 b	47.0±2.1 d	59.1±1.9de	71.1±2.1de	86.2±2.2 d	104.6±6.1 c
T1×SR3	50	11.2±1.1 a	19.1±1.1 a	32.2±1.5 b	45.2±2.1 d	56.0±1.9 e	67.2±2.1 e	81.0±2.2 d	98.2±6.1 c
T2×SR1	50	11.1±1.1 a	18.9±1.1 a	36.6±1.5 b	50.4±2.1cd	63.9±1.9cd	80.4±2.1 c	94.7±2.2 c	114.7±6.1 c
T2×SR2	50	11.4±1.1 a	22.1±1.1 a	45.4±1.5 b	60.0±2.1 b	76.6±1.9 b	95.4±2.1 b	116.5±2.2 b	151.4±6.1 b
T2×SR3	50	11.3±1.1 a	21.5±1.1 a	48.5±1.5 a	66.4±2.1 a	87.0±1.9 a	110.2±2.1 a	138.5±2.2 a	178.3±6.1 a
Overall mean	300	11.3±0.4	20.4±0.5	38.8±0.6	54.0±0.9	67.9±0.8	83.2±0.9	102.1±0.9	127.2±2.5

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

Table (4): Least-square means and standard error of the tested factors affecting on body weight (gm) 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	164.0±5.8 a	195.0±8.0 a	233.3±8.6 a	301.2±10.1a	366.0±11.7 a	419.5±10.7 a	461.0±8.6 a	505.8±7.4 a
T2 (artificial feed)	90	164.1±5.8 a	177.6±8.0 a	202.9±8.6 b	238.9±10.1b	271.7±11.7 b	311.1±10.7 b	343.3±8.6 b	371.9±7.4 b
Stocking rate (SR)		Ns	ns	ns	ns	**	***	***	***
SR1 (1000 tilapia + 100 S.carp)	60	163.9±7.1 a	188.0±9.3 a	223.5±10.6 a	289.4±12.3a	359.3±14.3 a	423.4±13.2 a	474.5±10.6 a	523.9±9.1 a
SR2 (1000 tilapia + 200 S.carp)	60	164.3±7.1 a	185.0±9.3 a	215.0±10.6 a	260.5±12.3a	305.6±14.3 b	349.7±13.1 b	383.0±10.6 b	421.0±9.1 b
SR3 (1000 tilapia + 300 S.carp)	60	164.0±7.1 a	185.8±9.3 a	215.9±10.6 a	260.3±12.3a	291.6±14.3 b	322.9±13.1 b	349.0±10.6 c	371.7±9.1 c
T × SR		Ns	ns	ns	ns	ns	***	ns	ns
T1×SR1	30	164.0±10.0 a	192.0±13.7 a	230.0±14.9 a	302.7±17.4a	393.8±20.3 a	466.7±18.6 a	521.6±14.9 a	585.2±12.9 a
T1×SR2	30	164.1±10.0 a	196.0±13.7 a	235.5±14.9 a	300.1±17.4a	355.5±20.3 ab	403.2±18.6 b	442.8±14.9 b	489.0±12.9 b
T1×SR3	30	163.9±10.0 a	196.2±13.7 a	234.5±14.9 a	300.8±17.4a	348.7±20.3 ab	388.7±18.6 b	418.7±14.9 b	443.3±12.9 c
T2×SR1	30	163.7±10.0 a	183.3±13.7 a	216.9±14.9 a	276.1±17.4a	324.8±20.3 b	380.1±18.6 b	427.3±14.9 b	462.7±12.9 bc
T2×SR2	30	164.5±10.0 a	174.0±13.7 a	194.4±14.9 a	220.9±17.4b	255.8±20.3 c	296.2±18.6 c	323.2±14.9 c	352.9±12.9 d
T2×SR3	30	164.0±10.0 a	174.4±13.7 a	197.3±14.9 a	219.7±17.4b	234.4±20.3 c	257.1±18.6 c	279.4±14.9 d	300.0±12.9 e
Overall mean	180	164.0±4.1	186.3±5.6	218.1±6.1	270.1±7.1	318.8±8.2	365.3±7.6	402.2±6.1	438.9±5.3

\+ Means with the same letter in each column are not significantly different.

* P<0.05 ** P<0.01 and *** P<0.001

Table (5): Least-square means and standard error of the tested factors affecting on 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±0.1 a	9.9±0.1 a	12.6±0.1 b	13.9±0.1 b	15.1±0.1 b	16.0±0.1 b	17.2±0.1 b	17.9±0.1 b
T2 (artificial feed)	150	8.1±0.1 a	10.8±0.1 a	13.0±0.1 a	14.7±0.1 a	16.0±0.1 a	17.4±0.1 a	18.3±0.1 a	19.7±0.1 a
Stocking rate (SR)		ns	***	***	**	**	*	***	**
SR1 (1000 tilapia + 100 S.carp)	100	8.1±0.2 a	9.5±0.1 b	12.0±0.2 b	14.5±0.2 a	15.3±0.1 b	16.5±0.1 b	17.3±0.1 c	18.4±0.2 b
SR2 (1000 tilapia + 200 S.carp)	100	8.1±0.2 a	10.2±0.1 a	13.0±0.2 a	13.9±0.2 b	15.5±0.1 b	16.8±0.1 a	17.7±0.1 b	18.8±0.2 ab
SR3 (1000 tilapia + 300 S.carp)	100	8.2±0.2 a	10.4±0.1 a	13.4±0.2 a	14.4±0.2 a	15.9±0.1 a	16.9±0.1 a	18.3±0.1 a	19.1±0.2 a
T × SR		ns	ns	***	***	***	***	***	***
T1×SR1	50	8.1±0.2 a	9.4±0.2 c	12.4±0.2 c	14.6±0.2 b	15.4±0.2 c	16.3±0.1 c	17.5±0.2 c	18.2±0.2 c
T1×SR2	50	8.1±0.2 a	10.1±0.2 ab	12.6±0.2 c	13.5±0.2 c	14.8±0.2 d	15.9±0.1 d	17.2±0.2 c	17.9±0.2 cd
T1×SR3	50	8.2±0.2 a	10.3±0.2 a	12.8±0.2 c	13.6±0.2 c	15.0±0.2 cd	15.9±0.1 d	17.0±0.2 c	17.4±0.2 d
T2×SR1	50	8.1±0.2 a	9.7±0.2 bc	11.7±0.2 b	14.4±0.2 b	15.2±0.2 cd	16.7±0.1 b	17.2±0.2 c	18.5±0.2 c
T2×SR2	50	8.1±0.2 a	10.6±0.2 a	13.5±0.2 a	14.4±0.2 b	16.2±0.2 b	17.7±0.1 a	18.2±0.2 b	19.6±0.2 b
T2×SR3	50	8.1±0.2 a	10.5±0.2 a	14.0±0.2 a	15.2±0.2 a	16.8±0.2 a	17.9±0.1 a	19.6±0.2 a	20.9±0.2 a
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

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

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

Independent variable	No.	initial	2-weeks	4-weeks	6-weeks	8-weeks	10-weeks	12-weeks	14-weeks
		Mean±SE	Mean±SE	Mean±SE	Mean±SE	Mean±SE	Mean±SE	Mean±SE	Mean±SE
Feeding treatment (T)		ns	ns	**	***	***	***	***	***
T1 (poultry litter)	90	25.33±0.30	25.64±0.37	27.73±0.37 a	30.56±0.36 a	32.14±0.33 a	33.56±0.29 a	33.58±0.24 a	35.66±0.24 a
T2 (artificial feed)	90	25.33±0.30	25.17±0.37	26.16±0.37 b	27.79±0.36 b	29.72±0.33 b	30.47±0.29 b	31.48±0.24 b	32.63±0.24 b
Stocking rate (SR)		Ns	Ns	Ns	ns	*	***	***	***
SR1 (1000 tilapia + 100 S.carp)	60	25.32±0.36	25.07±0.46	27.23±0.46 a	29.27±0.45 a	31.82±0.40 a	33.30±0.35 a	34.43±0.30 a	36.60±0.29 a
SR2 (1000 tilapia + 200 S.carp)	60	25.37±0.36	25.27±0.46	26.53±0.46 a	29.47±0.45 a	30.80±0.40 ab	31.77±0.35 b	31.88±0.30 b	33.95±0.29 b
SR3 (1000 tilapia + 300 S.carp)	60	25.32±0.36	25.88±0.46	27.07±0.46 a	28.78±0.45 a	30.18±0.40 b	30.97±0.35 b	31.42±0.30 b	31.88±0.29 c
T × SR		Ns	Ns	Ns	ns	*	Ns	**	*
T1×SR1	30	25.30±0.51	25.33±0.64	27.67±0.65 ab	29.93±0.63 ab	32.90±0.57 a	34.33±0.50 a	34.60±0.42 a	37.80±0.41 a
T1×SR2	30	25.37±0.51	25.20±0.64	27.27±0.65 ab	31.60±0.63 a	31.27±0.57 abc	33.53±0.50ab	33.07±0.42 b	35.10±0.41bc
T1×SR3	30	25.33±0.51	25.40±0.64	28.27±0.65 a	30.13±0.63 ab	32.27±0.57 ab	32.80±0.50 b	32.37±0.42 b	34.07±0.41 c
T2×SR1	30	25.33±0.51	25.80±0.64	26.80±0.65 ab	28.60±0.63 bc	30.73±0.57 bc	32.26±0.50b	34.27±0.42ab	35.40±0.41 b
T2×SR2	30	25.37±0.51	25.33±0.64	25.80±0.65 b	27.33±0.63 c	30.33±0.57 c	30.00±0.50 c	30.70±0.42 c	32.80±0.41 d
T2×SR3	30	25.30±0.51	25.37±0.64	25.87±0.65 b	27.43±0.63 c	28.10±0.57 d	29.13±0.50 c	29.47±0.42 d	29.70±0.41 e
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 and *** P<0.001

Table (7): Least-square means and standard error of the tested factors affecting on body depth (BD) of Nile tilapia.

Independent variable	No.	Initial	2-weeks	4-weeks	6-weeks	8-weeks	10-weeks	12-weeks	14-weeks
		Mean±SE	Mean±SE	Mean±SE	Mean±SE	Mean±SE	Mean±SE	Mean±SE	Mean±SE
Feeding treatment (T)		Ns	ns	ns	*	**	***	***	***
T1 (poultry litter)	150	2.71±0.06	3.38±0.04 a	4.21±0.05 a	4.65±0.06 b	5.04±0.04 b	5.07±0.03 b	5.40±0.04 b	5.80±0.05 b
T2 (artificial feed)	150	2.69±0.06	3.49±0.04 a	4.31±0.05 a	4.83±0.06 a	5.18±0.04 a	5.52±0.03 a	5.81±0.04 a	6.38±0.05 a
Stocking rate (SR)		ns	ns	**	***	**	***	***	**
SR1 (1000 tilapia + 100 S.carp)	100	2.69±0.07	3.37±0.05 a	4.17±0.06 b	4.92±0.08 a	5.05±0.04 b	5.15±0.04 b	5.48±0.05 b	5.93±0.07 b
SR2 (1000 tilapia + 200 S.carp)	100	2.70±0.07	3.53±0.05 a	4.22±0.06 b	4.44±0.08 b	5.22±0.04 a	5.36±0.04 a	5.58±0.05 b	6.12±0.07 b
SR3 (1000 tilapia + 300 S.carp)	100	2.71±0.07	3.40±0.05 ab	4.40±0.06 a	4.87±0.08 a	5.07±0.04 b	5.38±0.04 a	5.76±0.05 a	6.23±0.07 a
T × SR		nNs	***	ns	ns	***	***	***	***
T1×SR1	50	2.70±0.10	3.44±0.07 ab	4.12±0.08 b	4.88±0.11 ab	5.27±0.06 a	5.06±0.05 de	5.60±0.06 b	6.02±0.09 c
T1×SR2	50	2.70±0.10	3.49±0.07 ab	4.18±0.08 b	4.39±0.11 c	5.06±0.06 b	5.20±0.05 cd	5.40±0.06 c	5.90±0.09 c
T1×SR3	50	2.72±0.10	3.20±0.07 c	4.34±0.08 ab	4.67±0.11 bc	4.80±0.06 c	4.95±0.05 e	5.20±0.06 d	5.48±0.09 d
T2×SR1	50	2.68±0.10	3.30±0.07 bc	4.22±0.08 ab	4.95±0.11 ab	4.80±0.06 c	5.24±0.05 c	5.36±0.06 cd	5.84±0.09 c
T2×SR2	50	2.69±0.10	3.56±0.07 a	4.26±0.08 ab	4.48±0.11 c	5.38±0.06 a	5.52±0.05 b	5.75±0.06 b	6.34±0.09 b
T2×SR3	50	2.70±0.10	3.60±0.07 a	4.46±0.08 a	5.08±0.11 a	5.33±0.06 a	5.80±0.05 a	6.32±0.06 a	6.97±0.09 a
Overall mean	300	2.69±0.04	3.43±0.03	4.26±0.03	4.74±0.04	5.11±0.03	5.30±0.02	5.61±0.03	6.09±0.04

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

Table (8): Least-square means and standard error of the tested factors affecting on body depth (BD) of silver carp.

Independent variable	No.	Initial	2-weeks	4-weeks	6-weeks	8-weeks	10-weeks	12-weeks	14-weeks
		Mean±SE	Mean±SE	Mean±SE	Mean±SE	Mean±SE	Mean±SE	Mean±SE	Mean±SE
Feeding treatment (T)		Ns	*	***	**	***	***	***	**
T1 (poultry litter)	90	6.11±0.08	6.46±0.10 a	7.14±0.10 a	7.51±0.10 a	8.41±0.10 a	8.34±0.11 a	9.06±0.07 a	8.09±0.06 a
T2 (artificial feed)	90	6.11±0.08	6.16±0.10 b	6.51±0.10 b	7.10±0.10 b	7.69±0.10 b	7.63±0.11 b	8.03±0.07 b	7.84±0.06 b
Stocking rate (SR)		ns	ns	ns	*	**	***	***	***
SR1 (1000 tilapia + 100 S.carp)	60	6.10±0.10	6.10±0.12	7.05±0.13 a	7.58±0.13 a	8.20±0.12 a	8.56±0.13 a	9.17±0.08 a	8.90±0.08 a
SR2 (1000 tilapia + 200 S.carp)	60	6.12±0.10	6.36±0.12	6.78±0.13 ab	7.13±0.13 b	8.27±0.12 a	7.77±0.13 b	8.23±0.08 b	7.35±0.08 c
SR3 (1000 tilapia + 300 S.carp)	60	6.11±0.10	6.45±0.12	6.65±0.12 b	7.23±0.13 b	7.69±0.12 b	7.63±0.13 b	8.23±0.08 b	7.64±0.08 b
T × SR		ns	ns	*	ns	ns	ns	**	***
T1×SR1	30	6.10±0.14	6.46±0.17	7.20±0.18 a	7.78±0.18 a	8.33±0.17 ab	8.85±0.18 a	9.47±0.12 a	9.23±0.11 a
T1×SR2	30	6.10±0.14	6.37±0.17	7.00±0.18 ab	7.27±0.18 ab	8.67±0.17 a	8.13±0.18 b	8.97±0.12 b	7.00±0.11 e
T1×SR3	30	6.12±0.14	6.54±0.17	7.23±0.18 a	7.49±0.18 ab	8.23±0.17 ab	8.03±0.18 b	8.73±0.12 b	8.03±0.11 c
T2×SR1	30	6.10±0.14	5.74±0.17	6.90±0.18 ab	7.37±0.18 ab	8.07±0.17 b	8.27±0.18 b	8.87±0.12 b	8.56±0.11 b
T2×SR2	30	6.13±0.14	6.36±0.17	6.57±0.18 bc	6.98±0.18 b	7.87±0.17 b	7.40±0.18 c	7.50±0.12 c	7.70±0.11 d
T2×SR3	30	6.10±0.14	6.37±0.17	6.07±0.18 c	6.96±0.18 b	7.15±0.17 c	7.22±0.18 c	7.73±0.12 c	7.25±0.11 e
Overall mean	180	6.11±0.06	6.31±0.07	6.83±0.07	7.31±0.07	8.05±0.07	7.98±0.07	8.54±0.05	7.96±0.04

+ Means with the same letter in each column are not significantly different.

* P<0.05 ** P<0.01 and *** P<0.001

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

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

\+ Means with the same letter in each column are not significantly different.

* $P<0.05$ ** $P<0.01$ and *** $P<0.001$

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

Independent variable	No	Initial	2-weeks	4-weeks	6-weeks	8-weeks	10-weeks	12-weeks	14-weeks
		Mean±SE	Mean±SE	Mean±SE	Mean±SE	Mean±SE	Mean±SE	Mean±SE	Mean±SE
Feeding treatment (T)		Ns	ns	ns	**	*	**	***	***
T1 (poultry litter)	90	0.99±0.01 a	1.11±0.02 a	1.07±0.01 a	1.03±0.02 b	1.05±0.02 a	1.12±0.02 a	1.20±0.01 a	1.11±0.01 a
T2 (artificial feed)	90	0.99±0.01 a	1.06±0.02 a	1.08±0.01 a	1.09±0.02 a	1.00±0.02 b	1.04±0.02 b	1.07±0.01 b	1.04±0.01 b
Stocking rate (SR)		Ns	***	**	***	**	**	**	***
SR1 (1000 tilapia + 100 S.carp)	60	0.99±0.02 a	1.14±0.02 a	1.07±0.02 b	1.16±0.02 a	1.08±0.02 a	1.15±0.02 a	1.15±0.01 a	1.05±0.01 b
SR2 (1000 tilapia + 200 S.carp)	60	0.99±0.02 a	1.11±0.02 a	1.12±0.02 a	0.97±0.02 c	0.98±0.02 b	1.05±0.02 b	1.16±0.01 a	1.06±0.01 b
SR3 (1000 tilapia + 300 S.carp)	60	0.99±0.02 a	1.01±0.02 b	1.04±0.02 b	1.06±0.02 b	1.03±0.02 ab	1.05±0.02 b	1.10±0.01 b	1.12±0.01 a
T × SR		Ns	ns	**	*	***	ns	***	***
T1×SR1	30	0.99±0.02 a	1.17±0.03 a	1.07±0.03 ab	1.10±0.03 b	1.06±0.03 a	1.22±0.03 a	1.26±0.02 a	1.08±0.02 a
T1×SR2	30	0.98±0.02 a	1.13±0.03 a	1.15±0.03 a	0.90±0.03 c	1.08±0.03 a	1.06±0.03 b	1.21±0.02 a	1.13±0.02 a
T1×SR3	30	0.99±0.02 a	1.03±0.03 bc	0.98±0.03 c	1.08±0.03 b	1.02±0.03 a	1.08±0.03 b	1.12±0.02 b	1.12±0.02 a
T2×SR1	30	0.99±0.02 a	1.11±0.03 ab	1.06±0.03 b	1.21±0.03 a	1.10±0.03 a	1.08±0.03 b	1.04±0.02 c	1.01±0.02 b
T2×SR2	30	0.99±0.02 a	1.08±0.03 abc	1.09±0.03 ab	1.04±0.03 b	0.88±0.03 b	1.03±0.03 b	1.10±0.02 b	0.98±0.02 b
T2×SR3	30	0.99±0.02 a	1.00±0.03 c	1.09±0.03 ab	1.03±0.03 b	1.04±0.03 a	1.01±0.03 b	1.08±0.02 bc	1.13±0.02 a
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 and *** 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	3.50	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 × SR								
T1×SR1	3.97	3.70	2.86	1.13	0.96	1.61	1.25	2.22
T1×SR2	4.00	3.38	2.12	1.53	1.23	1.28	2.29	2.12
T1×SR3	3.56	3.48	2.26	1.43	1.22	1.25	1.28	2.07
T2×SR1	3.55	4.41	2.13	1.58	1.53	1.09	1.28	2.22
T2×SR2	4.41	4.80	1.86	1.63	1.46	1.33	1.75	2.46
T2×SR3	4.29	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 × SR								
T1×SR1	1.07	1.18	1.83	1.75	1.13	0.74	0.77	1.21
T1×SR2	1.19	1.22	1.62	1.13	0.84	0.62	0.66	1.04
T1×SR3	1.20	1.19	1.66	0.99	0.72	0.50	0.38	0.95
T2×SR1	0.75	1.12	1.61	1.08	1.05	0.78	0.53	0.99
T2×SR2	0.37	0.74	0.85	0.98	0.98	0.58	0.59	0.73
T2×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 bfeeding type and silver carp stocking rate.

Independent variable	Nile tilapia		Silver carp		total	
	Yield (kg)	%	Yield (kg)	%	yield (kg)	%
Treatment (T) *						
T1 (poultry litter)	324	70.1 %	291	100 %	615	92.1 %
T2 (artificial feed)	462	100 %	206	70.8 %	668	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 × SR						
T1×SR1	120	66.7 %	60	45.5 %	180	66.7 %
T1×SR2	108	60.0 %	99	75.0 %	207	76.7 %
T1×SR3	96	53.3 %	132	100 %	228	84.4 %
T2×SR1	121	67.2 %	47	35.6 %	168	62.2 %
T2×SR2	161	89.4 %	69	52.3 %	230	85.2 %
T2×SR3	180	100 %	90	68.2 %	270	100 %

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

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تأثير التسميد العضوى، الأعلاف الإضافية وكذلك معدل الكثافه على مكونات صفات النمو للبلطى النيلى والمبروك الفضى

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أجريت هذه التجربة فى الفتره من ١٥ مايو وحتى الأول من سبتمبر عام ١٩٩٥ وذلك بإستخدام ستة أحواض ترابيه بالمعمل المركزى لبحوث الثروة السمكية بالعباسه–مركز أبوحماد–محافظة الشرقيه. وقد استهدفت هذه التجربة دراسة تأثير إستزراع كثافات مختلفه من أسماك المبروك الفضى مع أسماك البلطى النيلى تحت نظام التربية المختلطه لأنواع الأسماك هذا بالإضافه إلى دراسة تأثير تسميد الأحواض تسميداً عضوياً بإستخدام فرشة الدجاج ودراسة تأثير ذلك على صفات النمو لأسماك البلطى والمبروك الفضى.

وعند بداية التجربة وضعت ١٠٠٠ سمكة من أصبعيات البلطى (٣ر١١ جرام) فى كل حوض ثم قسمت هذه الأحواض إلى مجموعتين تحتوى كل مجموعه على ثلاث أحواض ثم وضعت ١٠٠ سمكة مبروك فى الحوض الأول ، ٢٠٠ سمكه فى الحوض الثانى ، ٣٠٠ سمكه فى الحوض الثالث من كل مجموعه. هذا وقد سمدت الأحواض الثلاثه المكونه للمجموعه الأولى بإستخدام فرشة الدجاج بواقع ٥٠ كجم/أسبوع طول فترة التجربة وذلك بهدف تنمية الغذاء الطبيعى الميسر فى هذه الأحواض أما الأحواض الثلاثه المكونه للمجموعه الثانيه فقد غذيت بإستخدام أعلاف الأسماك المصنعه والمحتويه على ٣٠% بروتين خام وذلك بمعدل ٣% من وزن الأسماك الموجوده فى كل حوض يومياً (ستة أيام أسبوعياً) . ومن أهم النتائج المتحصل عليها مايلى:

١–لقد أظهرت النتائج أن وزن الجسم لأسماك البلطى النيلى والتى غذيت على علف الأسماك المصنع (٣٠% بروتين خام) كانت أكبر من تلك التى غذيت على الغذاء الطبيعى الناتج من التسميد العضوى بفرشة الدجاج وذلك من الأسبوع الرابع وحتى نهاية التجربة أما أسماك المبروك الفضى فقد أظهرت عكس هده النتائج.

٢–أظهرت كذلك نتائج هذه التجربة أن أوزان سمك البلطى النيلى قد زادت بزيادة كثافة المبروك الفضى التى أضيفت إلى أحواض تربية البلطى وكان ذلك مصحوباً بتناقص فى وزن أسماك المبروك الفضى وهدا بالطبع راجع إلى التنافس بين البلطى والمبروك الفضى على الغذاء الطبيعى المتاح للأسماك فى أحواض التربية.

٣–كما أظهرت كذلك نتائج هذه التجربة أن هناك تأثيراً وتفاعلاً مشتركاً بين نوع الغذاء وكثافة أسماك المبروك الفضى على وزن الجسم هذا بالإضافة إلى تأثير كل عامل منفرد على وزن الجسم.

٤–كانت أطوال وأعماق أجسام أسماك البلطى التى غذيت على أعلاف الأسماك الإضافية المصنعة أكبر من تلك التى غذيت على الغذاء الطبيعى فقط بينما أعطت أسماك المبروك الفضى نتائج عكسية وقد ظهرت هذه الفروق بداية من الأسبوع الثانى من التجربة بالنسبة لطول الجسم والأسبوع الرابع بالنسبة لعمق الجسم وهذه النتائج تشابه تلك التى حصلنا عليها بالنسبة لوزن الجسم ومعدل النمو النسبى لأسماك البلطى والمبروك الفضى.

٥-تشابهت قيم معامل الظروف بالنسبة للبلطى والمبروك الفضى مع تلك التى حصلنا عليها مع صفات النمو الأخرى سابقة الذكر وكان تأثير معدل الكثافة على معامل الظروف متغيراً بالنسبة لأسماك البلطى والمبروك الفضى طول فترة التجربة.

٦- أعطت المعاملة الغذائية الثانية قيم عالية لمعدل النمو النسبى وذلك من الأسبوع وحتى نهاية فترة التجربة مقارنة بتلك التى أعتطها المعاملة الغذائية الأولى لأسماك البلطى أما أسماك المبروك الفضى فقد أعطت النتائج العكسية وهذا راجع إلى إختلاف العادات الغذائية لنوعى الأسماك.

٧-أدت زيادة كثافة أسماك المبروك إلى زيادة معدل النمو النسبى لأسماك البلطى وتناقص معدل النمو النسبى لأسماك المبروك.

٨- حققت أسماك البلطى النيلى أفضل معدل نمو نسبى راجعاً إلى التداخل بين معدل الكثافة ونوع الغذاء وذلك خلال الأسابيع الأربعه الأولى حيث تراوح المعدل مابين ٧٦ر٣-٥٧ر٤ ووصل هذا المعدل إلى ٩٦ر.-٨٦ر٢ خلال العشرة أسابيع الأخيره من التجربة بينما حققت أسماك المبروك الفضى أفضل معدل نمو نسبى خلال الأسابيع الثمانية الأولى من التجربة حيث تراوح المعدل مابين ٣٧ر.-٨٣ر١ بينما وصل إلى ٣٨ر.-١٣ر١ خلال الستة أسابيع الأخيرة من التجربة.

٩-حققت أسماك البلطى النيلى ناتجاً كلياً مقداره ٤٦٢ كجم عندما غذيت على غذاء الأسماك المصنع الإضافى (المعاملة الغذائيه الثانية) وهذا الإنتاج أكبر من الذى حققته الأسماك التى ربيت فى الأحواض التى سمدت بالتسميد العضوى بإستخدام فرشة الدجاج (المعاملة الغذائية الأولى) حيث أعطت ٣٢٤ كجم بينما أعطت أسماك المبروك الفضى النتيجة العكسية حيث أعطت ٢٠٦، ٢٩١ كجم للأسماك التى حصلت على المعاملة الغذائية الثانية والمعاملة الغذائية الأولى على التوالى.

تزايد الإنتاج الكلى لأسماك البلطى والمبروك الفضى عند الحصاد مع زيادة كثافة أسماك المبروك الفضى. وبصفة عامه فإن أعلى إنتاج للبلطى والمبروك الفضى معاً ٢٧٠ كجم قد حصلنا عليه من المعاملة الغذائية الثانية (أعلاف الأسماك) مع الكثافه الثالثة. أما أقل المعاملات إنتاجاً (١٨٠ كجم) فقد حصلنا عليها من المعاملة الغذائية التى أستخدمت فيها الكثافة الأولى وإعتمدت فيها التغذية على الغذاء الطبيعى فى الحوض والذى تمت تنمية بالتسميد العضوى.