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دراسات بيولوجيه واقتصاديه على أسماك المبروك الفضى المرباه فى اقفاص تحت كثافات تسكين ومعاملات تسميد مختلفه

إعـــــــداد

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الهدف من التجربه دراسه تأثير التسميد بزرق الدواجن والطحالب الخضراء المزرقة على معدلات النمو والانتاجيه ومجموعات البلانكتون والكفاءه الاقتصاديه لأسماك المبروك الفضى حيث تم أجراء سته معاملات فى عدد ثلاثة وحدات من الأقفاص كل وحده تحتوى على ٤ اقفاص ومقاسات القفص الواحد ٦×٩ بعمق ٣متر ، المجموعة الاولى من الاقفاص ثم تسكين كثافتين من اسماك المبروك الفضى ٢٥٠٠-٥٠٠٠ اصبعية بمتوسط وزن ٥٠ جرام للقفص مع تسميدها برزق الدواجن بمعدل ٥كجم للقفص كل يومين عن طريق وضعهم فى جوال من القطن وتم تثبيتهم فى موقع القفص وتم تكرار كل معامله مرتين. والمجموعه الثانيه تم تسكين نفس الكثافات السابقه .الا انه تم تغذيتها بالطحالب الخضراء المزرقه بمعدل ٥% من اوزان الاسماك اسبوعياً اما المجموعه الثالثه تم تسكين نفس الكثافات السابقة ولكنها لم تعامل (غذاء طبيعى فقط).وقد نفذت الدراسة من اول سبتمر ٢٠٠٠وحتى اول يولية ٢٠٠١

افضل معدلات نمو تم الحصول عليها من المعامله الثانيه والتى أستخدم فيها الطحالب الخضراء المزرقه وتلى ذلك المعامله الاولى والتى استخدم فيها زرق الدواجن والزياده فى اوزان اجسام الاسماك كانت اكثر وضوحاً فى الكثافات المنخفضة.والمعاملة الثانيه بالطحالب الخضراء المزرقه والمعامله الاولى بزرق الدواجن حسنت الاعداد الكليه من البلانكتون النباتى والحيوانى على التوالى بالمقارنه بالمعامله االثالثة.

ومن الناحيه الاقتصاديه كانت افضل نسبه مئويه بالنسبه للعائد الصافى للتكاليف الكليه هى المعامله الثانيه يليها الاولى واخيرا المعامله الثالثه.

BIOLOGICAL AND ECONOMICAL INVESTIGATIONS OF SILVER CARP (Hypophthalmichthys molitrix) CULTURED IN CAGES AT DIFFERENT STOCKING DENSITIES AND MANURING TREATMENTS

By

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ABSTRACT

The present experiment aimed to study the effect of chicken manure fertilization, blue green Algae as well as stocking density on plankton communities, growth performance, productivity, and economic efficiency of growing silver carp (*Hypophthalmichthys molitrix*). The six treatments were done used three cage units each contained 4 cages each of 9x6x3 m^3 in diameters.

The first cage unit represented two stocking densities (2500 or 5000 fish fingerlings averaging 50 g in weight /cage) each in duplicate with application of fresh chicken manure in amounts of 5 kg / every second day per cage. Chicken manure was applied by filling it in cotton bags which was fixed at the cage sites. The second unit represented the same stocking densities cited above in duplicates with application of blue green algae in amounts of 5% of body weigh weekly. The third unit represented the same stocking densities cited above in duplicate without treatment (natural food only).This study was conducted from first September2000 to first July 2001.

The best growth rate was obtained with the second group fed on blue green algae followed by the first groups with applied chicken manure and the increases of body weighs of silver carp were more pronounced ($P<0.05$) at lower stocking density. Application of Blue green algae and chicken manure improved the total phytoplankton and zooplankton counts, respectively, compared with treatment natural food only.

Key words: Silver carp; stocking density; blue green algae; cages, economic efficiency

INTRODUCTION

The manure can be used from a direct or indirect integration of fish and livestock. In the direct integration system, fresh manure is added continuously to the ponds, while in the indirect integration the manure is transported to the ponds and used in fresh or treated forms in different manure regime (Peker, 1994).

Starling *et al.*, (1990) examined the impacts of three facultative planktivorous fishes, Congo tilapia (*Tilapia rendalli*), bluegill (*Lepomis macrochirus*) and tambaqui (*Colossoma macropomum*), and an obligate planktivorous fish, silvar carp (*Hypophthalmichthys molitrix*) on plankton community and water quality of a tropical eutrophic reservoir. Silver carp suppressed Copepod nauplii, Cladocerans and rotifers while the presence of tilapia and bluegill were associated with increased rotifers density. The dominant Blue- green algae, Cylindrospermopsis raciborkii (98% of phytoplankton biomass) was enhanced in the presence of bluegill, tilapia and tambaqui, but reduced in the presence of silver carp.

Bakeer, (2001) studied the effect of duck manure 20 kg. every second day per cage and stocking density (25and 50 fish /m^3) in cages .Results reveled that body weight and length increased significantly ($p<0.05$) and there was inverse relationship between the increases and stocking density.

The present investigation was performed to study the effect of chicken manure fertilization, Blue green Algae as well as stocking density on plankton communities, growth performance, total production, and economic efficiency of growing silver carp (*Hypophthalmichthys molitrix*).

MATERIALS AND METHODS

The present study was carried out in branch of the River Nile (Rasheed branch) at Behira Governorate, Egypt. The water at the experimental study had an average salinity ranging between 2-3 g/l. The experiment started at 1st September 2000and lasted at the 1st of July2001 (10 months).

Three cage units each contained 4 cages each of 9x6x3 m^3 in diameters. The first group of four cages represented two stocking densities 2500 or 5000 fish fingerlings averaging 50 g in weight /cage (15-30 fish/m^3) each in duplicate with application of fresh chicken manure in amounts of 5 kg / every second day per cage. Chicken manure was applied by filling it in cotton bags which fixed at the cage sites. The second group represented the same stocking densities cited above in duplicates with application of

blue green algae as feed in amounts of 5% of body weigh weekly. The third group represented the same stocking densities cited above in duplicate without treatment. Blue green algae were offered in floating fodder made of P.V.C pipes as a frame with a plate weed inside the frame to keep the plankton communities available for the fish.

The experimental chicken manure and Blue green algae were chemically analyzed according to the methods of AOAC (1990).The chemical composition of blue green algae and chicken manure are shown in (Table 1.)

Live body weight and length of a random sample of 150 fish from each cage were taken at start and every 15 days and were recorded till the termination of the experiment. The fish were netted from the water and weighed to the nearest gram. Standard length of fish was measured at the beginning and at the end of the experimental period to the nearest mm. Then the fish were returned immediately to their cages.

Measurements:

Water temperature, dissolved oxygen and pH were measured daily at 6°°a.m. and 12°° p.m. using temperature and dissolved oxygen meter (YSI model 57) and pH meter (model Corning 345). Transparency and Turbidity were measured every two weeks by sicchi disk and (Hack) spectrophotometer (model 41700) using Hack kits respectively. Determinations of water quality parameters (salinity, alkalinity, phosphorus and ammonia were carried out every month according to the methods of Boyd (1979). Phytoplankton and zooplankton communities in cage water were determined every month according to the methods described by Boyd (1990) and A.P.H.A (1985). Samples were collected from different sites of the experimental cage randomly to represent the water of the whole cages.

Parameters of specific growth rate (SGR %) and condition factor (K) was calculated according to the following equations:

$SGR\% = 100(\ln W_2 - \ln W_1)/T_2 - T_1$ (Bagenal and Tesch, 1978)

Where W_1 and W_2 are the first and following fish weight in grams, Ln is the natural logarithm and T is the growing period in days.

K= weight g x 100 /length cm^3 (Hopkins, 1992) Where W and L are the individual final weight and length of the fish.

After ten months of fish culture, silver carp was harvested from each cage and a sample of 150 fish was randomly taken for body weight and body length measures.

Statistical analysis:

The statistical analysis of data was carried out by applying the computer program of Harvey, (1990).Differences among means were tested for significance according to Duncan's multiple range test (1955).

RESULTS AND DISCUSSION

Water quality parameters

Averages water quality parameters as affected by manuring source are presented in table (2). Results revealed that Transparency (Sicchi disk reading in cm) had ranged between 14.1 cm and 15 cm. These values are beneficial to fish culture. In this connection, Mahmoud (1997), EL-Gendy (1998) and Abdel- Hakim, *et al* (2000) reported that poultry or duck manure, as organic fertilizers had no influence on Sicchi disk reading.

Turbidity is one of the physical properties that are greatly affected by culture of silver carp (*Hypophthalmichthys molitrix*). It has been determined in FTU had ranged between 124.5 and 126.6 which show a similar trend for all treatments. The same direction was observed in water temperature when the average was found to be between 27.00 C° and 28.8C° (table 2). The difference values of water temperature in cages fertilized and received blue green algae in all treatments may be attributing to the increase in organic matter contents of these ponds that may lead to temperature increases. These are in agreement with results of Mahmoud, (1997) and Abdel- Rahman, (2003) who reported a slight increase in water temperature with increasing manure. Transparency, turbidity and temperature values are in the range recommended for the fish species cultured in the six treatments.

Average of pH values for treatments T_1SR_1; T_1SR_2; T_2SR_1; T_2SR_2, $T_3SR_1$and T_3SR_2 were 8.1; 8.0; 8.4; 8.3; 8.5 and 8.8 respectively. The lower values of pH in cages fertilized (T_1 + T_2) may attribute to the increase in organic matter contents of these cages, which may lead to pH decreases. The acid and alkaline death points were found between pH 4 and 14 (Swingle, 1961 and Calabrese, 1969).

Averages of dissolved oxygen (DO) have ranged between 7.2 to 7.6 mg/L. These values are beneficial to fish culture and indicate that water dissolved oxygen slight decreased in cages fertilized compared to the other cages. This attribute to the increase in organic matter contents of these cages, which may lead to DO decreases.

Averages of phosphorus had ranged between 1.2 to 1.5 mg/L, which represent the normal range of phosphorus in fish cages. In this connection Fortes *et al* (1986) and Salama, (2003) showed that the available phosphorus was significantly ($P \leq 0.01$) highest in the chicken manure feed combination. They added that there are indications that phosphorus content of chicken manure increased that in the soil, although total phosphorus in the soil contributed by about 0.8 % of that in water.

Plankton communities:

Phytoplankton:

Results presented in table (3) illustrate the effect of treatments on phytoplankton communities. The total phytoplankton counts for treatments T_1SR_1; T_1SR_2; T_2SR_1; T_2SR_2; $T_3SR_1$and T_3SR_2 were 4524; 3918; 5258; 4528; 3780 and 3390 organisms/L, respectively on the average. Results presented in this table indicated that the phytoplankton total counts increased in the treated cages compared to the control. The results of table (3) indicate that the highest phytoplankton values were obtained by the T_2SR_1 and T_2SR_2 treatments followed in a decreasing order by T_1 and T_3 treatments, respectively. These results could be explained by the fact that blue green algae has more fertilization potential compared with other treatments. Results presented in table (3) revealed that Chlorophyta; Cyanophyto and Baccillariophyta recorded the highest counts (relatives T_2 group) followed in a decreasing order by $T_1$and T_3 groups, respectively.

The results of present study indicates that Chlorophyta is the dominated group followed by Cyanophyta and Bacillariophyta in all treatment cages.(tables 3).This community composition of phytoplankton reported in this study is in confirmation with observations of EL-Serafy and AL- Zahaby (1991), and Abdel- Hakim, *et al* (2000), who pointed out that Chlorophyta predominated all the other groups followed by Cyanophyta and Bacillariophyta .

Zooplankton Results presented in table (3) illustrate the effect of treatments on zooplankton communities in fish cages. The total zooplankton counts for treatments T_1SR_1; T_1SR_2; T_2SR_1; T_2SR_2, $T_3SR_1$and T_3SR_2 were 3037; 2537; 3270; 2846; 2515and 2188 organisms/L, respectively on the average. Results presented in this table indicated that the lowest total zooplankton counts were obtained by the treatment T_3 (control) followed in an increasing order by T_1, and T_2 treatments, respectively. The present study indicates that Rotifer is the dominant group followed by Copepoda and Cladocera in all the treatment cages. This community composition of zooplankton is not in conformity with observations of EL-Serafy and AL- Zahaby (1991), thus he pointed out that Copepoda was predominated all the other groups. These results may due to differences in the nature of the environmental conditions and feeding habits of the different fish species

These results indicate that the community composition of phytoplankton and zooplankton in the all treatments fluctuated greatly with temperature, fertilization and feeding habits of fish In this concern,

Riely (1947) reported that statistically the relation of total zooplankton and total phytoplankton had no strict relationship (not significant).

Based on the obtained results it could be recommended the use of blue green algae and chicken manure in cage culture of silver carp, thus it increased the phytoplankton counts in the water.

Growth performance:

Averages of body weight of silver carp as affected with stocking density and application of chicken manure during the experimental periods are presented in table (4). At the start of the experiment averages of initial weight ranged between 48.91 and 52.48 g. and differences between the experimental groups were insignificant indicating that distribution of experimental fish were completely random. Eight weeks after the experimental start results revealed that averages of body weight of silver carp increased significantly ($P<0.05$) in-groups receiving Blue green algae within each stocking density tested and the increase was more pronounced ($P<0.05$) at the lower stocking density. The same trend was observed during the all the experimental after the start of the experiment. At the end of experimental period 10 months, averages of final weights were 588.66; 564.36; 651.54; 608.62; 531.23 and 522.62g. for the groups T_1SR_1; T_1SR_2; T_2SR_1; T_2SR_2, $T_3SR_1$and T_3SR_2 , respectively (table 4).

The analysis of variance for final body weight indicate that final body weights of silver carp increased significantly ($p< 0.05$) with application of Blue green algae and the increase was more pronounced ($p< 0.05$) at lower stocking density . Table (5) also shows that the body length of silver carp increased from 13.3 to 40.1; 13.2 to37.5; 13.7 to 42.4;13.3 to 38.3; 12.9 to 39.8 and 13.2 to 35.7 cm. for T_1SR_1; T_1SR_2; T_2SR_1; T_2SR_2; $T_3SR_1$and T_3SR_2 , respectively. After 10 month of culture in cage culture and the values of fish condition factor were 1.21; 0.8; 1.15, 0.75,0.92 and 0.69 for T_1SR_1; T_1SR_2; T_2SR_1; T_2SR_2, $T_3SR_1$and T_3SR_2 , respectively.

The results indicate the application of blue green algae in cages stocked with silver carp fingerlings at a density of (2500 fish /cage) resulted in higher ($p<0.05$) final weight compared to the unmannered cages and manure cages with higher stocking densities .These results are in agreement accordance with results of Pullin and Shehadah (1980) reported that in creasing the are of manuring enhanced the growth rate of fish. Also Haftz and Abdel - Hakim (1998) reported that increasing the application rate of duck manure from 150 to 300 or 450 kg/feddan every two weeks increased significantly the final body weights of silver carp cultured in earthen ponds. They added also that final weights increased with decreasing stocking density from 4800 fish /feddan to 3200 fish / feddan. Furthermore, Abdel - Hakim *et al.*, (2000), reported that

increasing the level of poultry manure application from 150 to 300 or 450 kg/feddan every two weeks increased significantly the final weights of silver carp cultured in earthen ponds and the increase was more pronounced when the fish were stocked at lower density (3200 fish / feddan) compared to those stocked at higher density (4800 fish fedden)

As described in Table (6), the average body weight of silver carp increased from 50 to 553.27; 520.23; 648.48 ; 578.39,488.22 and 448.53 g. for T_1SR_1; T_1SR_2; T_2SR_1; T_2SR_2; $T_3SR_1$and T_3SR_2 , respectively. Daily gain (g) was between 1.32 and 1.98g.
Specific growth rate (SGR) recorded 0.79; 0.78; 0.83, 0.80, 0.74 and 0.73 for T_1SR_1; T_1SR_2; T_2SR_1; T_2SR_2; $T_3SR_1$and T_3SR_2, respectively. These values are in agreement with that reported by Bakeer, (2001), who found that SGR of silver carp was 1.3 when cultured in cage. The high value of daily gain and the other growth traits found in this study may be attributed to the presence of the natural food organisms which enhanced by the blue green algae.

Table (7) shows that, fish yields in the present study were 1427.5; 2708.92; 1579.98; 2921.37; 1274.95 and 2482.44 Kg./cage for T_1SR_1; T_1SR_2; T_2SR_1; T_2SR_2; $T_3SR_1$and T_3SR_2, respectively. As illustrated in table (7) The fish yield in the present study was higher than that obtained by Hafez, *et al.*, (1998) and Bakeer, (2001) who found that the total fish yields of silver carp were 12.7 and 12.9 kg/m^3 when there initial weights were 23.27 and 30.7, respectively.

Survival Rate

As shown in table (7) survival rate were 97; 96; 97; 96; 96 and 95%, for T_1SR_1; T_1SR_2; T_2SR_1; T_2SR_2; $T_3SR_1$and T_3SR_2, respectively. These results are in agreement with Bakeer, (2001), who obtained 97% survival rate for silver carp in cage culture

Economic Efficiency.

Table (7) shows the results of economical evaluation including the costs and returns for treatments applied in kg./ cage and income in (L.E) for 10 month. Total costs were 1300; 1925; 1245; 1870; 1225 and 1850 L.E /cage for T_1SR_1; T_1SR_2; T_2SR_1; T_2SR_2; $T_3SR_1$and T_3SR_2, respectively These results revealed that the total cost of T_1SR_2 (chicken manure) was the highest than other groups. On the other hand, the total cost of T_3SR_1 (natural food) was the lowest due to the absence of input costs. Net returns in L.E per cage were 5837.5; 11619.6; 6654.9; 12736.85; 5149.75 and 10562.2 for T_1SR_1; T_1SR_2; T_2SR_1; T_2SR_2 $T_3SR_1$and T_3SR_2, respectively.

Percentages of net return to total cost for treatments cited above were 449; 603.6; 534.5; 681.1; 420.3 and 570.9% for T_1SR_1; T_1SR_2; T_2SR_1; T_2SR_2; $T_3SR_1$and T_3SR_2, respectively, indicating that the highest net returns were obtained with the group T_2SR_2 (Blue green algae at a rate of 5% of body weight per week) followed by T1SR2 (fertilized with chicken manure in amounts of 5 kg / every second day per cage); T_3SR_2 and the other treatment groups, respectively. These results indicate that stocking of silver carp at a density of 5000 fish /cage (30 fish/m^3) with fertilized on blue green algae is the most profitable procedure for fish cage culturists.

Recommendation

Based on the obtained results, the use of dried blue green algae in cage culture could be recommended for growing silver carp (*Hypophthalmichthys molitrix*) and the fertilized rate was 5% of fish body weight every week, when the cage stocked with 5000fish(30 fish/m^3)weighing 50g /cage.

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Table (1): The chemical analyses of blue green algae and chicken manure on basis of dry matter.

Analysis% of Blue green algae					
Crude protein		**Ash**	**Vitamin C mg/100g**	**k**	**P**
9.62		**48.17.**	**3.5**	**0.27**	**0.89**
Analysis % of Chicken manure					
Crude protein %	**Carbon %**	**Nitrogen%**	**Phosphorus %**	**C:N Ratio**	**N:P Ratio**
9.83	38.39	1.64	0.29	23.41	5.66

Table (2): Averages of water quality parameters of cages during the experiment (10 months).

Treatment	Sicchi disk cm	Turbidity FTU	pH	D.O mg/L	Alkalinity mg/l ca co3	Salinity g/l	P2O5 mg/l	NH3 mg/l	Temperature C
$T_1 \times SR_1$	14.6	124.5	8.1	7.3	226	1.3	1.5	0.2	27.7
$T_1 \times SR_2$	15	124.6	8	7.2	254	1.3	1.4	0.2	28.8
$T_2 \times SR_1$	14.1	125	8.4	7.4	220	1.1	1.4	0.18	27
$T_2 \times SR_2$	14.5	126.6	8.3	7.4	200	1.2	1.5	0.28	28.6
$T_3 \times SR_1$	15	125	8.5	7.6	235	1.3	1.3	0.3	28.5
$T_3 \times SR2$	14.8	124.8	8.8	7.5	264	1.2	1.2	0.2	27.5

T_1 =Treatment (Chicken manure), T_2 =Treatment (Blue green Algae), T_3 =Treatment (Natural food)without fertilization or feeding
SR_2– (2500 fish/ cage), SR_1= (5000 fish/ cage)

Table (3): Least square means and standard errors for plankton abundance in all experimental groups.

	Phytoplankton (Organisms) L				
Treatments	**Chlorophyta**	***Cyanophyta***	**Bacillarophyta**	**Total. phytoplankton**	**% of the smallest value.**
	***	**	**	***	
$T_1 \times SR_1$	2123±43.4	1380±60.3	1021±34.3	4524±107.6	133.4%
$T_1 \times SR_2$	1895± 43.4	1213±60.3	810±34.3	3918±107.6	115.5%
$T_2 \times SR_1$	2483±43.4	1565±60.3	1210±34.3	5258±107.6	155.1%
$T_2 \times SR_2$	2337±43.4	1421±60.3	1918±34.3	4528±107.6	133.5%
$T_3 \times SR_1$	1798±43.4	1312±60.3	670±34.3	3780±107.6	111.5%
$T_3 \times SR_2$	1638±43.4	1122±60.3	630±34.3	3390±107.6	100%
Zooplankton (Organisms)L					
Treatments	**Rotifer**	**Copepod**	**Cladocera**	**Total zooplankton**	**% of the smallest value.**
	**		**	***	
$T_1 \times SR_1$	1452±18.5	898±25.8	687±24.2	3037±103.2	138.8%
$T_1 \times SR_2$	1290±18.5	718±25.8	529±24.2	2537±103.2	115.9%
$T_2 \times SR_1$	1615±18.5	891±25.8	764±24.2	3270±103.2	149.4%
$T_2 \times SR_2$	1439±18.5	725±25.8	682±24.2	2846±103.2	130%
$T_3 \times SR_1$	1234±18.5	765±25.8	516±24.2	2515±103.2	114.9%
$T_3 \times SR_2$	1130±18.5	615±25.8	443±24.2	2188±103.2	100%

+ Mean of 12 samples (2 replicates and 6 samples for each replicate)

** P<0.01 *** P<0.001

Table (4): Means and standard error (Mean±SE) for the effect of treatments on the body weight (BW) of Silver carp (*H. molitrix*)

Variable	Start (BW1)	2 monthes (BW2)	4 monthes (BW4)	6month (BW6)	8 month(BW8)	10 month(BW10)
Treatment (T)						
Chicken manure	50.15±0.57 a	143.50±0.24 b	253.15±1.06 b	368.18±1.15 b	589.44±1.18 b	602.98±2.68 a
Blue green Algae	50.34±0.57 a	150.78±0.24 a	275.20±1.06 a	390.54±1.15 a	650.27±1.18 a	659.62±2.68 a
Natural food	50.32±0.57 a	145.62±0.24 a	239.67±1.06 a	359.62±2.68 a	450.43±2.68 a	569.62±2.68 b
Stocking rate (SR)						
SR_1 (2500 fish/ cage)	50.11±0.66 a	149.27±0.61 a	273.70±0.18 a	391.70±1.30 a	521.18±1.72 a	610.42±3.16 a
SR_2 (5000 fish/ cage)	50.02±0.47 a	133.08±0.61 b	247.48±0.18 b	367.44±1.30 b	510.15±1.21 b	568.28±4.13b
T × SR						
T1× SR_1	50.23±0.93 a	168.14±1.21 b	267.89±1.67 b	388.65±1.84 b	553.27±2.42 b	588.66±4.37 b
T1× SR_2	48.91±0.66 a	156.96±0.86 b	254.47±1.34b	374.70±1.30 b	520.23±1.72 b	564.36±3.09 b
T2× SR_1	52.48±0.23 a	172.37±1.25 a	299.51±1.67 a	419.90±1.78 a	648.48±2.14 a	651.54±4.32 a
T2× SR_2	51.53±0.66 a	156.19±0.16 a	270.48±1.18 a	391.18±1.30 a	578.39±1.71 a	608.62±3.10 a
T3× SR_1	51.71±0.57 a	148.62±2.65 c	239.62±2.68 c	335.62±1.08 c	488.22±2.68 c	531.23±2.61 c
T3× SR_2	49.81±0.14 a	139.68±2.68 c	235.16±2.18 c	339.64±1.21c	448.53±2.32c	522.62±2.68 c
Overall mean	50.77±0.53	156.99±1.64	261.18±1.59	374.94±1.41	539.52±2.16	577.83±3.36

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

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

□ (BW1, BW2,.....) after two month, after four month...

Table (5): Means and standard error (Mean±SE) for the effect of treatments on the body Length (BL) of Silver carp (*H. molitrix*)

Variable	No.	Start (BL1)	2 monthes (BL2)	4 monthes (BL4)	6month (BL6)	8 month(BL8)	10 month(BL10)
Treatment (T)							
Chicken manure	150	13.3±0.08 a	15.49±0.08 b	19.92±0.09 b	25.98±0.10 b	32.02±0.13 b	41.4±0.18 b
Blue green Algae	150	13.2±0.08 a	16.03±0.08 a	21.08±0.09 a	26.58±0.10 a	33.35±0.13 a	43.2±0.18 a
Nutural food	150	13.8±0.18 a	15.86±0.18 b	18.86±0.18 b	25.16±0.18 b	31.86±0.18 b	38.3±0.18 b
Stocking rate (SR)							
SR1 (2500 fish/ cage)	100	13.4±0.09 a	17.22±0.09 a	22.06±0.10 a	27.70±0.11 a	32.73±0.15 a	41.2±0.20 a
SR2 (5000 fish/ cage)	200	13.1±0.07 a	16.57±0.07 b	19.94±0.07 b	25.36±0.08 b	31.65±0.11 b	38.2±0.14 b
T × SR							
T1×SR1	100	13.3±0.13 a	17.30±0.17b	22.21±0.15 b	27.37±0.16 b	32.12±0.21 b	40.1±0.29 b
T1×SR2	200	13.2±0.09 a	16.30±0.13 b	21.05±0.10 b	25.62±0.11 b	31.39±0.15 b	37.5±0.19 b
T2×SR1	100	13.7±0.13 a	17.14±0.17 a	22.56±0.15 a	28.04±0.16 a	33.30±0.21 a	42.4±0.28a
T2×SR2	200	13.3±0.09 a	16.46±0.09 a	21.00±0.10 a	27.52±0.11 a	32.41±0.15 a	38.3±0.20 a
T3×SR1	100	12.9±0.18 a	15.86±0.12 c	19.46±0.18 c	25.26±0.08 c	31.46±0.13 c	39.8±0.16 c
T3×SR2	200	13.2±0.23 a	15.45±0.12 c	19.16±0.18 c	25.00±0.08 c	31.38±0.13 c	35.7±0.16c
Overall mean	900	13.26±0.14	16.41±0.13	20.90±0.14	26.46±0.11	32.04±0.16	38.9±0.21

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

Table (6): Growth performance of Silver carp in cage culture.

Treatments	T_1		T_2		T_3	
	SR1	SR2	SR1	SR2	SR1	SR2
Body weight						
Initial Body Weight (g)	50.22^{a} ±1.18	48.91^{a} ±1.18	52.48^{a} ±1.18	51.53^{a} ±1.18	51.71^{a} ±1.18	49.81^{a} ±1.18
Final Body weight (g)	588.66^{b} ±4.37	564.36^{b} ±3.09	651.54^{a} ±4.32	608.62^{a} ±1.48	531.23^{c} ±2.61	522.62^{c} ±2.68
Weight gain (g)	538.44	515.45	599.06	557.09	479.52	472.81
Daily gain (g)	1.79	1.71	1.99	1.85	1.59	1.57
S.G.R(% 1 day)	0.82	0.81	0.83	0.82	0.77	0.78
Body length						
Initial Body length (cm)	13.3^{a} ±1.38	13.2^{a} ±1.38	13.7^{a} ±1.38	13.3^{a} ±1.38	12.9^{a} ±1.38	13.2^{a} ±1.38
Final Body length (cm)	40.1^{b} ±0.29	35.7^{b} ±0.19	42.4^{a} ±0..28	38.3^{e} ±0.20	39.8^{c} ±0.16	35.7^{c} ±0.16
Condition factor(K)						
Initial (K)	2.13^{a}	2.12^{a}	2.04^{a}	2.19^{a}	2.40^{a}	2.16^{a}
Final (K)	0.91^{a}	1.24^{b}	0.85^{a}	1.08^{b}	0.84^{a}	1.14^{b}

Table (7): Economic efficiency (%) of Silver carp in cage culture. L.E/ cage(162 m^3).

Item	T_1		T_2		T_3	
	SR1	SR2	SR1	SR2	SR1	SR2
Stocking data						
Stocking rate (No / cage)	2500	5000	2500	5000	2500	5000
Average size at stoking (g)	50	50	50	50	50	50
Average size at harvesting	588.66	564.36	651.54	608.62	531.23	522.62
Survival rate %	97.0%	96.0%	97.0%	96.0%	96.0%	95.0%
Production Kg /cage(162 m^3).						
Fish(Silver carp)	1427.50	2708.92	1579.98	2921.37	1274.95	2482.44
A- Operating costs						
Fish fingerlings	625	1250	625	1250	625	1250
Fertilization(manure)	75	75	-	-	-	-
Blue green algae	-	-	20	20	-	-
Labor (one cage)	500	500	500	500	500	500
Taxes (one cage)	100	100	100	100	100	100
Total costs/cage	1300	1925	1245	1870	1225	1850
% of the smallest value of total costs	106.1%	175.1%	101.6%	152.6%	100%	151%
B- Returns						
Total Returns	7137.5	13544.6	7899.9	14606.85	6374.75	12412.2
Net returns	5837.5	11619.6	6654.9	12736.85	5149.75	10562.2
C-% Net return to total cost	449%	603.6%	534.5%	681.1%	420.38%	570.9%

The economical evaluation of results was carried out according to market prices in 2001 in L.E.