JOURNAL OF THE
ARABIAN AQUACULTURE SOCIETY

Vol. 1 No 2
December 2006

Effect of stocking density and manuring rate on silver carp (*Hypophthalmichthys molitrix*)reared in earthen ponds

Bakeer , M.N.[1] and Tharwat , A.A.[2]

1. Aquaculture Department Central Laboratory for Aquaculture research, Abbassa.

2. Department of Animal Production , Faculty of Agriculture, Cairo University. Giza, Egypt.

ABSTRACT

Six treatment groups were conducted in earthen ponds , each of total area of 0.38 feddan. The ponds were stocked with silver carp fingerlings weighting 49.8 - 50.3g. at the experimental start .The ponds included three stoking densities (SD500- SD 1000 and SD1500) and two manuring rates (MR)within each density tested (MR100 and 150 kg poultry manure /pond /week)with two replicates for each pond. The experimental period lasted 210 day.The parameters of body weight (BW) , body length (BL), condition factor (K), specific growth rate (SGR) and total fish production were recorded . Economical evaluation of the various treatment groups of the experiment was also calculated . Results obtained can be summarized in the following :(1) Treatment applied had released significant effects on gains in live weights, k and SGR. (2) Under both manuring rates (100 and 150 kg poultry manuring /pond /week), total body weight and body length decreased significantly ($P<0.05$) with each increase in the stocking density . (3) Final body weight and body length of groups stocked at the same density increased significantly ($P<0.5$) with the increase in the manuring rate from 100 to 150 kg poultry manure /pond/week at the densities tested. (4) Increasing the fish stocking density resulted in an increase in the total fish yield in all treatments tested . (5) The highest net return was obtained by SD500 MR100 group followed in a decreasing order by the other groups .

Key words: Silver carp, Earthen pond, Stocking density, Monuring rate, Growth parameters, Economic efficiency

.

INTRODUCTION

Silver carp *Hypophthalmichthys moltrix* (valenciennes), a species native to China, is filter-feeding omnivores. The fish has been widely introduced throughout the old for aquaculture and it is contributing 22% (>3 million tones) of world carp aquaculture production (FAO,2005) .Silver carp widely used for biological control of plankton in aquaculture ponds, ;lakes , reservoirs and swage lagoons .It may reduce the prevalence of cyano-bacterial off-flavors (Tucker, 2006). One of the major problems faced by rapidly growing aquaculture is the availability of

fish feed, since feed is the largest operating cost of seminternsive fish farming. Feeding cost often constitutes more than 50% of the total cost of production in intensified culture system (Sehagal and Toor, 1991 and De Silva, 1992).

The nutritional value of natural food organism is sufficient to support excellent fish growth. They are a rich source of protein , often containing 40-60% protein on dry matter basis (De Silva *et al* .,1991) . 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 regimes(Peker, 1994 and Pillary 1995). Miller (1976) noted that as natural food becomes over harvested due to intensive stoking , fish will accept supplementary feeding. Woynarrovich (1980) and Barash *et al*. (1982) reported that phytoplankton and zooplankton production increased significantly due to duck manure which provides a continuous supply of organic matter containing important elements, carbon , nitrogen and phosphorus required to increase the natural food supply. Therefore, the integration of crop and livestock farming with fish culture has been successful because of the complementary nature of the input and output characteristics of the different systems (Lightfoot *et al* .,1993). The output from one part of the system becomes an input to another part of the system and in this way the best use is made of the nutrient and energy inputs to the farming system, so minimizing nutrient leakage (potentially polluting wastes) and potential economic loss (Midlen and Reddin, 1998).

Sliver carp is a surface feeder feeding mainly phytoplankton; it takes also artificial feed (Pillay, 1995). Hafez and Abdel Hakim (1998) reported that body weight and length of sliver carp reared in earthen pond increased significantly with increasing the level of duck manure. Bakeer (2001) reported that applications of duck manure increased final body weights of silver carps reared in cage culture. Also Bakeer *et al*. (2003) studied the effect of chicken manure fertilization Blue green algae as well as stocking density on plankton communities, growth performance and total production of silver carp growth .They reported that the best growth rate was obtained with the groups fed on blue green algae followed by chicken manure. Mohamed and Mahmoud (2006) evaluate the ferilization requirements of the Chinese carp fry during the nursing phase, they rported that nurising of bighead carp and silver carp fry requires more fertile water than that required for grass carp fry and monoculture system is preferable for the fry during the nursing stage .Market demand as table fish for silver carp is poor when compared with other fish but the fast growth during first year grows to 1.5 to 2 kg makes it an attractive species (GAFRD,2005).

The aim of this work was to evaluate the effect of stocking density and manuring rate on growth performance and total fish production of silver carp. *H.molitrix* reared in earthen ponds.

MATERIALS AND METHODS

This study was carried out at the experimental fish station of the Central Laboratory for Aquaculture Research, Abbassa . Twelve earthen ponds were used, each of 0.38 feddan (50× 32.0 × 1m)= 1600m^2 two replicates for each treatment .The experimental design is illustrated in the following:

Treatment 1: 500 fish pond + Manuring rate 100 kg / pond / week (SD_1+MR_1)

Treatment 2: 500 fish / pond + Manuring rate 150 kg / pond / week (SD_1 +MR_2)

Treatment 3: 1000 fish / pond + Manuring rate 100 kg / pond / week (SD_2 + MR_1)

Treatment 4: 1000 fish / pond + Manuring rate 150 kg / pond / week (SD_2 + MR_2)

Treatment 5: 1500 fish / pond + Manuring rate 100 kg / pond / week (SD_3 + MR_2)

Treatment 6: 1500 fish /pond + Manuring rate 150 kg / pond / week (SD_3 + MR_2)

Poultry manure was obtained from El-Ahlia company. The experimental ponds were supplied with freshwater from Ismaelia canal. The water level was maintained at approximately 1 m and loss of water due to evaporation and leakage was replaced whenever necessary .

At the start of the experiment silver carp fingerlings from Abassa hatchery (General Anthority for fish Rsources Development) averaging in weight from 29.4 to 30.89 were randomly allocated into the six treatment groups as given before. At harvesting (210 day after start) sampls of 150 fish from each pond were taken randomly and body weight (BW) and body length (BL) were measured .Specific growth rate (SGR) was calculated according to Jauncey and Rose (1982) using the following formula;

$$SGR= 100 [(Ln\ wt._2 - Ln\ wt._1) / t]$$

where Ln = the natural Log, $wt._1$ = first fish weight in grams, $wt._2$ = following fish weight in gams, t=period in days .

Water samples were biweekly collected from fish pond after three days of the fertilization. Dissolved oxygen in ponds water were determined daily during the whole experimental period at 6a.m. and water temperature was recorded two times (6 a.m., and 3p.m.)daily using an oxygen meter (YSI model 57). The pH values were measured weekly by an electrode pH meter (model corning 345). The concentrations of ammonia, total alkalinity, nitrate, nitrite and orthophosphate were determined according to Boyd (1981). The water visibility and turbidity were determined using Secchi disk to predict the availability of natural food in ponds . The economic efficiency for fish production was calculated , based on the labor work , cost of fingerlings , fertilizer and the price of the fish production according to the market price at the time of harvesting .

The data were statistically analyzed using the computer software program of Harvey (1990). Duncan's multiple range test (Duncan, 1955)was applied to compare the significance ($P \leq 0.05$) of means of the various parameters among the tested treatments.

RESULTS AND DISCUSSION

Water Quality

All water quality parameters tested throughout the experimental period revealed that all parameters were within the permissible levels for optimum fish growth. The mean values of water quality parameters in ponds for the complete rearing period were ranged as follows :temperature 27-28.7 ^{o}C; pH 8-8.5; dissolved oxygen (DO)6.0-6.8mg/L, alkalinity 338-374 mg / L free ammonia (NH_3) 0.05 - 0.08 mg / L, available phosphonrus (orthophosphate) 3.2 - 3.8 mg / L; and transparency (Secchi-disk reading) 25-30cm .All these values were not different significantly among the treatments and were within the permissible limits in pond water for fish culture as reported by Boyd(1982) .This certainly appears to be the case , as other factors that can dramatically affect fish performance , such as water quality or fish health , were similar in all treatments .Brett(1979) stated that feeding rate is one of the most important factors affecting fish performance.

Growth performance

The growth performance of silver carp reared in the earthen ponds throughout seven months on poultry manure is shown in Table (1) .The application of two manuring rates (100 or 150 kg poultry manure /pond/week) revealed that average of fish body weight increased significantly ($P<0.05$) in groups receiving higher poultry manure within each stocking density tested and the increase was more pronounced ($P<0.05$) at e lower stocking density ,.Based on results of body length at the end of the experiment, it indicated that higher rate of poultry manure in the ponds increased the final length and that growth in length was more pronounced when fish stocked at lower densities compared to the other groups . Although, it was noticed a positive relationship between the manuring rate and daily again in all treatments , the specific growth rate haven't significantly affected by manuring rate .Generally, the highest fish growth (final body weight, final body length, daily gain and specific growth rate)was obtained by the lowest stocking density and higher manuring rate (500fish/pond treated with 150 kg manure / pond / week) followed by the same stoking density with 100 kg manure/pond/week. While the lowest growth performance was obtained by the highest stocking density treated with lowest mauring rate (1500 fish/100 kg manure /pond/week) ,.These results are in agreement with results of sliver carp cultured at different stoking densities in

cages using duck manure (Bakeer, 2001) .Also , Hafez and Abdel –Hakim (1998) reported that increasing duck manure rat from 150 to 30 or 450 kg/Feddan every two weeks increased significantly the final body weights of sliver carp cultured in earthen ponds. They added also that final weights increased with decreasing with decreasing stocking density from 4800fish/Feddan to 3200 fish/ Feddan. Moreover Abdel – Hakim *et al*, (2000[b]) reported that increasing the level of poultry manure application from 150 to300 or 450 kg/Feddan ever two weeks increased significantly the final weights of sliver carp cultured in earthen ponds and the increase was more pronounced when the fish were stocked at lower density (3200fish/Feddan) compared to those stocked at higher density (4800fish/Feddan). Analysis of variance for the SGR indicates that the higher values ($P<0.05$) were obtained by lower stocking density of silver carp (500 fish/pond) followed by medium stocking (1000fish/pond) followed by the higher stocking rate (1500 fish/pond) regardless to the poultry manure rate.

Table (1): ***Means and standard error (Mean ± SE) of the effect of stocking density (SD) and manuring rate (MR) on body measurements condition factor (k) , daily gain (g) and specific growth rate (SGR) of silver carp.***

Variable	Initial weight (g)	Final weight (g)	Initial length (cm)	Finial length (cm)	Condition factor (k)	Daily gain (g)	Specific growth Rate, SGR (% day)
Stocking density(SD)							
SD_1(500 fish/pond)	49.4±0.76a	1114.20±1.085a	10.75±0.08a	44.76±1.13a	1.24±0.03a	5.07±0.02a	1.48±0.02a
SD_2(1000 fish/pond)	50.3±0.76a	792.75±1.85b	10.65±0.08a	43.70±1.13b	0.94±0.03b	3.53±0.02b	1.31±0.02b
SD_3(1500 fish/pond)	49.7±0.76a	573.40±1.85c	10.85±0.08a	42.60±1.13c	0.74±0.03c	2.49±0.02c	1.16±0.02c
Manuring rate (MR)							
MR_1(100kg/ pond/week)	49.4 ±0.78a	812.23±1.55b	10.83±0.09a	42.90±1.41b	1.02±0.03a	3.63±0.03b	1.33±0.02a
MR_2(150kg/ pond/week)	50.3±0.78a	841.33 ±1.55a	10.66±0.09a	44.40±1.41a	0.96±0.03b	3.76±0.03a	1.34±0.02a
SD × MR							
$SD_1 \times MR_1$	50.2±0.79a	1097.9±1.88 b	10.80±0.09a	44.00±1.81b	1.28±0.02a	4.98±0.02b	1.49±0.03a
$SD_1 \times MR_2$	49.8±0.79a	1130.5±1.88a	10.70±0.09a	45.50±1.81a	1.20±0.02b	5.14±0.02a	1.49±0.03a
$SD_2 \times MR_1$	49.4±079a	780.4 ±1.88 d	10.70±0.09a	43.00±1.81c	0.98±0.02c	3.48±0.02c	1.31±0.03b
$SD_2 \times MR_2$	50.3±0.79a	805.1±1.088c	10.60±0.09a	44.40±1.81b	0.91±0.02d	3.59±0.02c	1.32±0.03b
$SD_3 \times MR_1$	49.4±0.79a	558.4±1.88f	11.00±0.09a	41.90±1.81d	.075±0.02d	2.42±0.02e	1.15±0.03c
$SD_3 \times MR_2$	50.8±0.79a	588.4±1.85e	10.70±0.09a	43.40±1.81c	0.71±0.02e	2.56±0.02d	1.16±0.03c

Means with different letters in each column are significantly ($P<0.05$).

Many authors (Cremer and Simtherman , 1980 and Hafrez and Adel – Hakim, 1998) showed the SGR values of silver carp reared in earthen ponds increased linearly with each increase in the level of duck manure and the increase was more pronounced at lower stocking densities .Average value of condition factor (k) of SD1 MR1 was significantly the highest value ($P<0.05$) comparing with all other treatment. However, Cremer and Smitherman (1980) and Hafez and Abdel-Hakim (1998) reported that neither application rate nor stocking density had significant effects on condition factor of silver carp reared in earthen ponds. Their results may be caused by the low fat and gross energy contents of the pond natural food organisms .helper (1988) stated that natural food organism contain low energy, while protein is in excess, therefore , it is expected that fish consuming only natural food have minmal fat and maximal protein accumulation in their body .

Survival Rate

At the end of experiment , the surviving fish in all treatments were apparently good, and the survival percentages exceed 80% in all treatments (Table 2) .However , the survival rate has a negative relationship with the stoking density (SD) where, it decreases from 90.60% at SD 500 to 80.5% at SD 1500 fish/pond, In respect to the effect of manuring rate on the survival rate within the different treatments , it was found that the survival rate increased at manuring rate of 150 kg/pond/week within the low stocking density (500fish/pond) .Inversely, It was found that the survival rate at the higher stocking density (1500fish/pond) decreased by using of the higher manuring rate (150kg/pond/week) .Wile the survival rate at the medium stoking density has not affected by the manuring rate .

Table (2). *Least squire means and standard error for the effect of treatments on survival rate of silver carp reared in earth ponds*

Items	No of ponds	Survival rate
Stocking density (SD)		
SD_1(500 fish/pond)	4	90.60± 1.28 a
SD_2(1000fish/poond)	4	85.10±1.028b
SD_3(1500 fish/pond)	4	80.5±1.28c
Manuring rate (MR)		
MR_1 (100 kg/pond/week)	6	85.50±1.28b
MR_2(150 kg/pond/week)	6	85.84±1.28a
SD× MR		
SD_1xMR_1	2	90.51 ±1.34b
SD_1xMR_2	2	90.71± 1.34a
SD_2xMR_1	2	85.10 ±1.34c
SD_2xMR_2	2	85.11±1.34c
SD_3xMR_1	2	80.90±1.34d
SD_3xMR_2	2	80.10±1.34e

Means with different letters in each column are ignificantly different ($P<0.05$).

Total Yield

Data in Table (3) revealed that the increase of stocking from 500 to 1000 fish/pond led to enhancing the total yield up to 134.5% , while the highest stocking density of 1500/fish/pond relatively declined the total yield to 113.6% .However , it was found a negative relationship between the average fish weights and stocking density, where the average fish weight decreased from 114 to 573 g with the increase of stocking density from 500 to 1500 fish/pond. On the other hand, the increment of manuring rate from 100 to 150 kg / pond increased the total yield to about 104 %, and also increased the average fish weight from 812 to 841g. In comparison of all treatments, it was found that the highest average fish weight (1130.5g) was obtained by the second treatment $SD_1 \times MR_2$, while the highest total yield was obtained by he sixth treatment $SD_3 \times MR_2$ (1866.4 kg / Feddan). These results are in agreement with the findings of Mohmoud (1997) and Hafez and Abdel-Hakim (1998) , they reported that pond yield of silver carp increased in a linear manner with each increase in duck manure level from 150 to 300 or 450 kg/Feddan biweekly and with each increase in fish stocking density.

Table (3): *Total yield of silver carp (Kg / Fadden) as affected by stocking density and manuring rate (kg / Feddan).*

Treatments	Total yield (kg) / pond	Average weights (g)	Total yield (kg) / Feddan	%of the smallest value yield
Stocking density (SD)*				
SD_1(500 fish/pond)	504.79	1114.25	1328.39	100%
SD_2(1000fish/poond)	679	792.75	1787.18	134.53%
SD_3(1500 fish/pond)	692.28	573.40	1508.94	113.59%
Manuring rate (MR)**				
MR_1 (100 kg/pond/week)	612.28	812.33	1508.2	100%
MR_2(150 kg/pond/week)	637.94	841.33	1574.79	104.41%
SD ×MR				
SD_1xMR_1	496.85	1097.90	1307.50	100%
SD_1xMR_2	512.73	1130.50	1349.21	103.19%
SD_2xMR_1	664.12	780.40	1747.68	133.66%
SD_2xMR_2	694.14	805.10	1826.68	139.70%
SD_3xMR_1	677.61	558.40	1783.18	136.38%
SD_3xMR_2	706.96	588.40	1866.42	142.72%
Over all mean	**625.40**	**826.78**	**1646.79**	

**Each value is an average of 4 ponds (2 manuring rate x2 replicates).*

***Each value is an average of 6 ponds(3 stocking densities ´ 2 replicates).*

The present results are relative in agreement with other studies (Boyd 1981; Olah 1986 and Diana *et al*. 1991) indicated that and fertilization (applications of organic and /or) inorganic fertilizers) increases yield production. However, Green (1992) and Diana et al (1994) added that supplemental feeding in fertilized ponds resulted in significantly higher growth rates and greater yields than fertilization alone .

Economic Evaluation

Details of the economics of fish production are given in Table (4), the total costs including the variable and fixed factors , takes and the interest on working capital for the treatments were applied in L.E . and returns as L.E /Feddan for all treatments .It was obvious that nay increment of stocking density or manuring rate or both of them led to increase the total cost gradually for the six treatments .The percentages of net returns(%) to total costs were 288.6, 269.6, 190.1 , 182.4 , 132.6 and 128.6 % for the SD_1 MR_1, SD_1 MR_2, SD_2 MR_1, SD_2 MR_2, SD_3 MR_1 and SD_3 MR_2 groups, respectively.

Table (4): *Cost and returns as affected with feeding rate and stocking density of silver carp reared in earthen ponds in (L.E / Feddan) **

Parameter	**$SD_1 \times MR_1$**	**$SD_1 \times MR_2$**	**$SD_2 \times MR_1$**	**$SD_2 \times MR_2$**	**$SD_3 \times MR_1$**	**$SD_3 \times MR_2$**
Costs , LE						
Price of fingerlings	355.26	355.26	710.52	710.52	10378	1065.78
Price of poultry litter	400	600	400	600	400	600
Labour	200	200	200	200	200	200
Equipment(pump and others)	200	200	200	200	200	200
Weed control, LE	200	200	200	200	200	200
Rent / Fadden, L.E	1000	1000	1000	1000	1000	1000
Total cost, L.E	**2355.26**	**2555.26**	**2710.52**	**2910.52**	**3065.78**	**3265.78**
Returns, LE						
Total yield, kg / Feddan	1307.50	1349.28	1747.68	1826.68	1783.18	1866.42
Price of soled one kg fish, LE*	7	7	4.5	4.5	4.0	4.0
Total income per Feddan, LE	9152.5	9444.96	7864.0	8220.06	7132.72	7465.68
Net returns (total income –total costs), LE	6797.24	6889.7	5153.48	5309.54	4066.94	4199.9
Economic efficiency (%)	288.59	269.62	190.12	182.42	132.65	128.60

* The economical evaluation results were carried out according to market prices at harvest time in L.E.

* The price of soled fish carried out according to fish size.

However, the economical analysis of all production parameters indicated that the highest economic efficiency (%) was obtained by the first treatment 500 fish/pond with manuring rate of 100 kg per week followed by a decreasing order in the other treatments. These results revealed that the total costs of SD_1MR_1 were the lowest due to the manuring rat the other groups .These results are in partly agreement with the results of Abdel-Hakim *et al*. (2000), working with the other fish species reared in cages.

Based on the present results, significant improvement in natural food, best of yield and net profit with higher growth performance and production of sliver carp, it can be concluded that silver carp could be cultured in earthen ponds at a stocking density of 500 fish/ pond applied with 100 kg poultry manure /pond/week proved to be more efficient in economic terms, followed in a decreasing order by the higher stocking density or manuring rate as in other groups .This information is important to fish farmers as a management tool to achieve optimum fish growth , production and profitability.

REFERENCES

Abdel-Hakim, N. F.; Hafez, A. F.; El-Helali, E. A. and Hassan , A.A. 2000. Effect of poultry dry manure (PDM) levels on silver carp performance ,Egypt. Agric. Res., 78(2):893-917.

Abdel - Hakim, N.F.; Bakeer, M.N. and Soltan, M. A. 2000. Growth performance of eel (*Anguilla anguilla*), Nile tilapia (*Orecohromis niloticus*) and grey mullet (*Mugil cephalus*) cultured in cages under two feeding systems .Proc.3rd All Africa Conf. Anim. Agric .& 11th Conf. Egyptian Soc. Anim ,Prod, Alexandria, Egypt. 6-9 Noverber pp:329-335.

Beeker, M.,N. 2001 .Growth responses of sliver carp (*Hypophthalmichthys molirtrix*) cultured in cages to manuring at different stocking densities .Annals of Agric .Sc.,Moshtohor , 39(3):1517-1529.

Beeker, M. N.; Salam,A.R.;Abdel Gawad,A.S. and Nossiear ,M.A. 2003. Biological and economical investigations of silver carp (*Hypophthalmichthys molitrix*) cultured in cages at different stocking densities and manuring .treatments .Annals of Agric. Sc., Moshtohor, 41(2):621-636.

Barash, H.;Plavink, I .and Moav, R. 1982. Integration of duck and fish

farming Experimental Results .Aquaculture , 27;129-134

Boyd , C.E. 1981 . Fertilization of warm water fish ponds .Journal of Fish Soil and Water Conservation, 36: 142-145.

Boyd, VC.E. 1982 Water Quality Management for Pond Fish Culture. Elservier Scientific Publishing, New York ,USA .

Brett, J.R. 1979. Environmental factors and growth .In :Fish Physiology, Vol.VIII. Bioenergetic and Growth (ed.By W.S.Hoar,D;J.Randall & J.R.Brett),pp.599-675. Academic Press , London.

Cremer, M. C. and Smitherman, R.O. 1980. Food habits and growth of silver and bighead carp in cages and ponds .Aquaculture, 20:27-64.

De Silva , S. S. 1992 . Fish nutrition research for semi-intensive culture systems in Asia Asian Fisheries Science 5 :129-144.

De Silva, S. S; Gunaseker, R. M. and Shim ,K.F. 1991. Interactions of varying dietary protein and lipid levels in young red tilapia: evidence of protein sparing .Aquaculture, 95:305.

Diana , J. S. Lin ., C.K. and Jaiyen , K. 1994 . Supplemental feeding of tilapia in fertilized ponds.Journal of the World Aquaculture Society, 25:497-506.

Diana, J.S.; Lin, C.K. and Schneebergeer, P.J. 1991. Relationship among nutrient inputs , water nutrient concentrations ,primary production, and yield of *Oreochrmis niloticus* in ponds .Aquaculture, 92: 323-341.

Duncan, D. B. 1955, Multiple range and multiple F test .Biometrucs , 11:-1-46.

GAFRD 2005. Annula Statistics of General Authority for Fish Resources Development , Nassr City Cairo ,Egypt.

FAO 2005. FISHSTAT PLUS, version 2.30. Food and Agriculture Organization of the United Nations, Rome, Italy .http://www.fao.org/fi/statist/FISOFT/FISHPLUS/asp.

Green, B. W. 1992. .Substitution of organic manure for pelleted feed in tilapia production .Aquaculture , 101: 213- 222.

Hafez, A. F. and Abdel-Hakim , N.F. 1998. Performance of silver carp as affected by level of duck manuring and stocking density. Egypt .J. Agric .Res.,76(3) :1297-1305.

Harvey ,W. R. 1990.User's guide for LSMLMW. mixed model least-squares and maximum likedlihood computer program. Ohio State University .Colmbus. USA.

Hepher, B. 1998 .Nutrition of Pond Fishes. The Press Syndicate of the University of Cambridge ,Cambridge.

Jauncey, K. and Ross, B. 1982. A Guide to Tilapia feeds and feeding. Institute of Aquaculture .University of Stirling . Stirling.

Lightfoot, C.; Biombao, M.A.; Dalsgaard, J.P.T. and Pullin, R.S.V. 1993. Aquaculture and sustainability through integrated resources management .Outlook on Agriculture, 22(3):143-150.

Mahmoud , A. A. 1997. Effect of duck manure as organic fertilizer on productivity of silver carp under Egyptian conditions .M.Sc. Thesis .Faculty of Agriculture, Al-Azhar University ,Egypt.

Mildlen , A. and Redding , T. 1998. Environmental Management for Aquaculture , Chapman and Hall , London, 215 pp.

Miller, J.W. 1976 . Fertilization and feeding practices in warm water fish pond aquaculture in Africa ..CIF A Tech. Pap. 4 (suppl .1) 512 (BRI, 15.000258).

Mohamed , G.A. and Mahmoud , A.A. 2006. Evaluate the fertilization requirements of Chinese carp fry(silver carp, bighead carp, grass carp) during the nursing phase. J. Agric .Sci .Mansoura Univ., 31(5), May , 2006.

Olah, J. 1986 . Carp production in manured ponds. In : Aquaculture of Cyprinids (ed. by R. Billard & J.Marcel), pp. 95-303. IRNA, Paris.

Peker, F. 1994. Organic carbon production and related fish yields in intensively manured fishponds .Fish Culture Research Institute, Hungary.

Pillary, T.V.R. 1995. Aquaculture Principles and Practices .Fishing News Books , Oxford ,541 pp.

Sehagal , H.S. and Toor, H.S. 1991. Comparison of feeding strategies based on biomass and biomass-pond interactions .In :Fish Nutrition Research in Asia (ed. By S.S. De Silva), pp.181-192 .Asian Fisheries Society , Manila, Philippines

Tucker , C.S. 2006. Low-density silver carp *Hypophthalmichthys molitrix* (valenciennes) polycuilture does not prevent cyanobacterial off-flavours in channel catfish *Ictalurus punctatus* (

Rafinesque) Aquaculture Research, 2006, 37:209-214.

Woynarovich , E. 1980. Raising ducks on fish ponds .ICLARM Conf. Proc., 4 : 129-34.

تأثير كثافة التخزين ومعدل التسميد على أداء أسماك المبروك الفضى المرباه في الأحواض الترابية

محمد نجيب بكير[١] – عادل أحمد ثروت [٢]

١-قسم الاستزراع السمكى – المعمل المركزى لبحوث الثروة السمكية بالعباسة شرقية – مركز البحوث الزراعية

٢- قسم الإنتاج الحيوانى - كلية الزراعة - جامعة القاهرة.

تم إجراء ستة مجموعات من المعاملات التجريبية فى الأحواض الترابية ، مساحة كل حوض ٠.٣٨ فدان وتم تخزين اصبعيات أسماك المبروك الفضى بوزن ابتدائى٤٩.٨ – ٥٠.٣ جم . احتوت هـه الأحواض على ٣ كثافات ٥٠٠-١٠٠٠-١٥٠٠ سمكة / حوض) بمستوين تسميد (١٠٠-١٥٠كجم زرق دجاج /حوض/ أسبوعيا) باستخدام مكررتين لكل معاملة واستمرت التجربة ٢١٠ يوما . ثم تسجيل وزن الجسم وطوله ، معامل الحالة ،ومعدل النمو النوعى ، الانتاج الكلى للأسماك وكذلك تم حساب التقييم الاقتصادى للمعاملات المختلفة للتجربة . ومن أهم النتائج المتحصل عليها ما يلى :

١- المعاملات المختلفة التى تم تطبيقها لها تأثيراً معنوياً على العائد من الوزن الحى ، ومعامل الحالة، ومعدل النمو النوعى .

٢- كثافة التخزين ومعدل التسميد كان لها تأثيراً معنوياً على وزن وطول الجسم الذى يقل معنويا مع زيادة كثافة التخزين.

٣- وزن الجسم النهائى سجل زيادة معنوية مع نفس الكثافة السمكية فى حالة زيادة معدل التسميد من ١٠٠- ١٥٠ كجم زرق دواجن للحوض فى الأسبوع وظهر ذلك فى جميع الكثافات المختبرة .

٤- زيادة الكثافة السمكية أدت إلى زيادة المحصول السمكى الكلى ولكن دون تحقيق جدوى اقتصادية مناسبة

٥- افضل عائد اقتصادى تم الحصول عليه عند كثافة تخزين ٥٠٠ سمكة للحوض مع معدل تسميد ١٠٠كجم زرق دواجن / حوض /أسبوع بالمقارنة بكثافة تخزين ١٥٠٠،١٠٠٠ سمكة / حوض .