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IMPACTS OF DIFFERENT FIRTILIZATION PROGRAMS IN A POLYCULTURE SYSTEM ON WATER QUALITY PARAMETERS, FISH PRODUCTION AND ECONOMIC RETURNS

Kamal[1], S. M., Azazy[2], G. and Soliman[3], A. M.

1- *Aquaculture Dep., Central Laboratory for Aquaculture Research, Agricultural Research Center, Egypt*
2- *Fish Economy Dept., Central Laboratory for Aquaculture Research, Agricultural Research Center, Egypt*
3- *Limnology Dept., Central Laboratory for Aquaculture Research, Agricultural Research Center, Egypt.*

ABSTRACT

Polyculture, i. e. the rearing of more one fish species in the same culture system, is regarding as a reliable way to increase productivity without addition expenses. In semi-intensive aquaculture systems, cultured fish can rely on natural food, produced through fertilization, up to certain size. Beyond this size, supplemental diet becomes imperative to sustain optimum fish growth. The application of fertilization to fish ponds should be optimized. In this regard, the present study was carried out to examine different levels of organic fertilization (poultry manure) in earthen fish ponds, and polycultured with Nile tilapia, *Oreochromis niloticus* (L.); silver carp, *Hypophthalmichthys molitrix* (V.), common carp, *Cyprinus carpio* (L.) and grass carp *Ctenopharyngodon idella*. Ponds were fertilized for the first 5 months with inorganic fertilizer(5 kg of urea (46.5% N) and 15 kg of super phosphate (15.5% P_2O_5) / pond / 2 week) and three levels of organic fertilizer (20, 40 and 60 kg/pond/2weeks) without artificial feeding. Nine earthen ponds (one feddan each) were used in this study divided into three treatments, T_1 (20 kg poultry manure/ponds /2 week), T_2 (40 kg poultry manure/ponds/2week) and T_3 (60 kg poultry manure/ponds/2 week). Each pond was stocked with 10,000 Nile tilapia fingerlings (10.5 g), 300 silver carp fingerlings (11.2 g), 50 common carp fingerlings (10.5g) and 50 grass carp fingerlings (10.2g). The supplemental diet (25% protein) was provided to the ponds at rate of 3% of fish body weight 5 days a week at the last two months only. Water quality analyses revealed that water temperature, pH, salinity, nitrate and nitrite were not significantly affected by fertilizing rate, while dissolved oxygen, EC., TDS, total hardness, orthophosphate and organic nitrogen were significantly ($P< 0.05$) increased with increasing fertilizer levels. Average of Secchi disk reading was significantly ($P< 0.05$) lower at higher fertilizing rates. Chlorophyll *a* content also was directly correlated to organic fertilizing rate. The maximum growth of Nile tilapia, silver carp and grass carp was obtained at fertilizing rate of 60kg/pond (T_3), while the maximum growth of common carp was obtained at fertilizing rate of 20 kg poultry manure/ponds/2 week (T_1). The highest total fish production was obtained at fertilizing rate of 60 kg poultry manure/ponds/2 week (T_3). With regard to economic efficiency, although T_3 recorded the highest total cost however; it recorded the highest net return and economic efficiency and it can tolerate both production and price risk.

In conclusion, this study suggested that the optimum fertilizing rate of poultry manure for Nile tilapia, common carp, grass carp and silver carp reared in a polyculture system; in earthen pond is 60 kg/pond/2 week alternatively with inorganic fertilizers, with feeding on commercial diet during last 2 months only.

KEY WORDS. Polyculture, water quality, Nile tilapia, *Oreochromis niloticus*, common carp, *Cyprinus carpio*, grass carp *Ctenopharyngodon idella*, silver carp, *Hypoph-thalmichthys molitrix*, fertilization, poultry manure, fish growth.

INTRODUCTION

Culturing fish in polyculture system makes better use of land and water as it results in greater fish yields, together with higher economic returns than mono culture (Glap *et al.*, 2005). Polyculture of Nile tilapia *Oreochromis niloticus* L., common carp, *Cyprinus carpio* L., grass carp *Ctenopharyngodon idella* and silver carp, *Hypoph-thalmichthys molitrix* Val. is the major aquaculture practice in Egypt and other countries in the world. The combination of the three species may ensure maximum utilization of available natural food in ponds because of their different feeding habits. Silver carp, Nile tilapia, and common carp could be considered as surface, column, and substratum feeders, respectively (Cremer and Smitherman, 1980 and Spataru *et al.*, 1983). The three species are commonly cultured in semi-intensive system with fertilization and supplemental feeding. Using of filter-feeding phytoplanktivorous fish species such as silver carp can effectively reduce the growth of harmful algae as well as increasing fish prodction, Zhang *et al.* (2006) indicated that the phytoplanktivorous silver carp can be an efficient biomanipulation fish to reduce nuisance blooms cyanobacteria.

Management strategies in the lower levels of intensification involve the use of fertilizers to encourage natural productivity and to improve the levels of dissolved oxygen. Fish yields from such techniques have been found to be higher than those from natural unfertilized systems (Hickling, 1962; Hepher, 1963 and Green, 1992). Artificial feed costs in aquaculture operations account for approximately 50% of total operational costs (Keenum and Waldrop 1988; Ratafia 1994) and is considered a major constraint for both small fish farms and commercial fish aquaculture ventures. Reducing amount of feed is a means of lowering costs if production is not reduced. In attempts to reduce feed costs, fish farmer provide supplemental feed for part instead of all of the grow-out operation. An on-farm trial, carried out in the Philippines, demonstrated that initiation of feeding of Nile tilapia after 75 d of stocking in ponds produced the same yield as initiation at 45 days (Brown et al., 2000).

The present study aimed to evaluate the effect of applying inorganic and different levels of organic fertilizer for the first five months with introducing supplemental feed at last two months in a polyculture system on fish production, water quality parameters and economic return.

MATERIALS AND METHODS

The present study was carried out in Central Laboratory for Aquaculture Research at Abassa, Sharkia governorate, Egypt. Nine earthen ponds one feddan each and water depth 1 m in average during the experimental period were used in this study. The experimental earthen ponds represented three treatment according to level of organic fertilizer, the first treatment (T_1) fertilized with chicken layer manure 20 kg/pond/2week, second treatment (T_2) fertilized with chicken layer manure 40 kg/pond/2week and third treatment (T_3) fertilized with chicken layer manure 60 kg/pond/2week. Each treatment was performed in triplicate.

Before starting all fish ponds were drained completely and then were exposed to sun rays for 2 weeks till complete dryness. Ponds were then refilled with fresh water coming from Ismailia Nile branch throughout El-Gad'oon irrigation canal to the production station. Supply and drainage pipes were equipped by nylon screen to prevent fish escape and / or entry. Ponds were fertilized by weekly alternated aplication during the experimental period, the first 5 months inorganic (5 kg of urea (46.5% N) and 15 kg of super phosphate (15.5% P_2O_5) / pond and different levels of organic fertilization only used without feeding. The inorganic fertilizers were dissolved and splashed on the water surface. Fertilization was sandwiched with commercial pelleted fish feed 25% protein by the rate of 3% of fish body weight twice daily at 9.00 and 13.00 O'clock six days a week for the last two months.

At the beginning of the experiment (1 May), each pond was stocked with10,000 Nile tilapia (10.5 0.05 g), 300 silver carp (11.3 0.05 g), 50 common carp (10.5 0.6g), and 50 grass carp (10.1 0.35 g), fish were adapted to the new conditions for one hour, then distributed randomly into nine earthen ponds one feddan each.

Water temperature, dissolved oxygen, pH and water visibility were measured daily at 9a.m. using thermometer, dissolved oxygen meter (YSI model 57), pH meter (model Corning 345) and Secchi disk (SD), respectively. Determinations of total hardness was measured as $CaCo_3$ according to the methods described in APHA (1985), total ammonia was carried out every two weeks by nesslerization methods of (APHA, 1985). Nitrate-nitrogen (NO_3-N), Nitrite-nitrogen (NO_2-N), Total phosphorous and orthophosphate were measured according to the methods described in APHA (1985). Salinity was determined by conductivity meter (Orion 630), while chlorophyll "a" was determined according to standard methods (APHA, 2000). Samples were collected from different sites of the experimental ponds randomly to represent the water of the whole pond. Live boay weight 50 fish at start and monthly there after were recorded till the termination of the experiment and at the end all fish in each pond were collected, weight and counted.

Statistical analysis

Data were analyzed using one and two-way ANOVA with fertilization levels and growth parameters of different fish species as factors. Statistical significance was set at the $P<0.05$ probability level and means were separated using Duncan's new multiple range test. The software SPSS, version 12 (SPSS, Richmond, USA) was used as described by Dytham (1999).

RESULTS AND DISCUSSION

Water quality parameters:

The measurements of some physico-chemical parameters in water under different experimental treatments are shown in Table (1). Average of dissolved oxygen values recorded during the experiment were significantly increased from first treatment to third one (4.06±0.14, 5.10±0.20 and 6.09±0.07 mg/l, respectively). These results indicated that the DO affected by organic fertilization. These results may be due to that organic fertilizers act as an energy source for bacterial growth and the aerobic decomposition of organic matter by bacteria, which could be considered an important drain of oxygen supplies in ponds (boyd, 1981).

Data obtained alongside the study period concerning water temperature as represented in Table (1) showed that there were no significant differences ($P<0.05$) among different treatments. Average means of water temp. among different treatments were between 27 and 27.06 °C. which lies within the optimum range of tilapia tolerance (24 -32 °C) mentioned by El-Sayed and Kawanna (2008). pH ranged between 8.50 and 8.55. Boyd (1998) reported that waters with a pH range of 6.5 – 9 are the most suitable for fish production. The average values of seechi disk readings were significantly decreased from first treatment to third one (23, 15 and 10 cm) for T_1, T_2 and T_3, respectively. The significant decrease in seechi disk reading less than 20 cm for T_2 and T_3 indicates that pond is too turbid, which may be due to either phytoplankton or suspended soil particles (Boyd 1998). Since Organic material is commonly used to remove clay turbidity from water (Boyd, 1982), so phytoplankton appear to be the principal factor in lowering secchi disk in this experiment. It increases water turbidity, resulting in low Secchi disk transparency (Boyd 1990). The average concentration of total ammonia (NH_4-N) was 0.410, 0.313 and 0.366 mg/l for T_1, T_2 and T_3, respectively. Some studies showed the same trend for lower ammonia concentration; Diana and Lin (1998) reported ammonia concentration of 0.374 – 0.410 mg/l in ponds fertilized with both chicken manure and inorganic fertilizers in combination. This low concentration of total ammonia may be attributed to ammonia utilization by phytoplankton (Knud- Hansen and Pautong, 1993 and Boyd, 1998) or to oxidation of ammonia to nitrate, especially in high dissolved oxygen conditions (Boyd, 2000). Rhyne *et al.* (1985) refer the consumption of ammonia may be due to algae. The European Inland Fisheries Advisory Commission (1993) reported that the toxic level of NH_4 to fish is 2 mg/L. The values of nitrite and nitrate concentration ranging between 0.018 - 0.058 mg/L and 0.175 - 0.281 mg/L, respectively. Diana and Lin (1998) noticed that nitrite and nitrate concentration ranging between 0.374 – 0.410 mg/l and 0.438 – 0.461 mg/l, respectively, in ponds fertilized with both chicken manure and inorganic fertilizers. There were no significant differences between treatments ($P<0.05$). Electric conductivity values were significantly higher ($P<0.05$) in T_2 and T_3 than in T_1. This could be explained by the increased concentration of different ions associated with chicken layer manure application to ponds water as an organic fertilizer (Boyd, 1990). Santerio and Pinto-Coellho (2000) reported that applying organic fertilizers significantly increased water electric conductivity. There were no significant differences (P<0.05) between treatments in salinity values. It was 0.40 ppt for the three treatments. Stickney, (1986) mentioned the range 0-10‰ as an optimum salinity range for *O. niloticus*. Data of total dissolved solids (TDS), Total hardness (TH), Total phosphorus (TP), orthophosphate (OP) and organic nitrogen (ON) are summarized in Table (1) showed highly significant differences between the three treatments during the experiment. They were increased with increasing the level of fertilization from 20kg to 60 kg / fedd./ 2 week (Abd-El-Hakim *et al.* 2006). Chlorophyll "a" recorded the highest value in the third treatment (251.09 µg/l) followed by the second and first treatment (198.11 and 182.93 µg/l) indicating that there was a higher level of phytoplankton production. so these results confirms that phytoplankton appear to be the principal factor in lowering secchi disk in this experiment.

Table 1: Monthly means ± SE of physicochemical parameters of water samples collected from production pond during the experimental period.

Variables	Treatments		
	T_1	T_2	T_3
Do (mg/l)	4.06 ± 0.14^c	5.10 ± 0.20^b	6.09 ± 0.07^a
Temp. (°C)	27.06 ± 0.07^a	27.00 ± 0.00^a	27.00 ± 0.00^a
pH	8.50 ± 0.28^a	8.52 ± 0.28^a	8.55 ± 0.14^a
SD (cm)	23.00 ± 0.73^a	15.00 ± 0.57^b	10.00 ± 0.57^c
NH4-N (mg/l)	0.410 ± 0.006^a	0.313 ± 0.010^b	0.366 ± 0.015^a
EC (µmhos/cm)	0.779 ± 0.011^b	0.840 ± 0.008^a	0.840 ± 0.018^a
Salinity ppt.	0.40 ± 0.00^a	0.40 ± 0.00^a	0.40 ± 0.00^a
TDS (ppm)	0.488 ± 0.007^b	0.542 ± 0.011^a	0.534 ± 0.013^a
TH (mg/l)	202.00 ± 1.52^b	214.82 ± 2.16^b	260.33 ± 1.66^a
OP (mg/l)	0.013 ± 0.002^c	0.069 ± 0.002^b	0.088 ± 0.003^a
TP (mg/l)	0.373 ± 0.005^c	0.445 ± 0.006^b	0.659 ± 0.002^a
NO2-N(mg/l)	0.058 ± 0.041^a	0.018 ± 0.002^a	0.023 ± 0.002^a
NO3-N(mg/l)	0.175 ± 0.007^a	0.281 ± 0.006^a	0.267 ± 0.114^a
ON(mg/l)	21.55 ± 0.80^c	24.40 ± 0.54^b	28.20 ± 0.68^a
Chl"a" µg/l	182.93 ± 1.35^c	198.11 ± 2.27^b	251.09 ± 3.04^a

Fish performance

As described in Table (2), Average initial live body weight among the different experimental treatments ranged between 10.5 and 10.6g for tilapia, 11.1 and 11.3g for silver carp, 10.5 and 10.69 g for common carp and 10.1 and 10.28 g for grass carp (Table 2). Statistical analysis showed that no significant differences ($P>0.05$) in initial body weight among the experimental treatments were observed.

The growth responses of fish species in all the treatments were generally satisfactory, and they all reached the marketable size at the end of the experiment. Fish grown on low level of fertilization at 20 kg chicken manure / pond / 2 week (T_1) achieved a reasonable growth and production, while increased the level of fertilization up to 60 kg chicken manure / pond / 2 week (T_3) resulted in more rapid growth and higher production (Table 2) than the tow low level of fertilization 20 and 40 kg chicken manure / pond / 2 week (T_1 and T_2). In the three species (tilapia, silver carp and grass carp) it is clearly shown (table 2) that all the tested growth parameters for tilapia (final body weight (FW), total gain (TG), total average daily gain (TADG), average daily gain (ADG) and total yield (TY) in the treatment fertilized with chicken manure 60 kg / pond (T_3) surpassed all other groups (T_1 and T_2). Followed by T_2 and T_1, repectively. With regard to FW, TG and TY Statistical analysis showed that there were significant differences ($P<0.05$) between treatments. But in the case of ADG no significant differences was observed between T_2 and T_3. On the other hand, no significant differences was observed between treatmenrs in TADG. With regard to silver carp (Table 2) it is obvious that T_3 recorded higher ($P> 0.05$) final body weight (FW) (1085.0±0.57 g/fish) than T_2 (931.66±1.7 g/fish) and T_3 (864.00±1.15 g/fish). The same trend was obtained with regard total gain (TG), total average daily gain (TADG), average daily gain (ADG) and total yield (TY). With regard to grass carp (Table 2) It is obvious that T_3 recorded higher ($P<0.05$) final body weight (FW) 1433.33±1.76 g/fish than T_2 (1341.00±2.08 g/fish) and T_1 (1297.00±1.15 g/fish). The same trend was obtained with regard total gain (TG), average daily gain (ADG) and total yield (TY). No significant differences was observed between treatmenrs in total average daily gain (TADG). These results are in agreement with results obtained by Chang (1998) who reported that fertilization was commonly used to enrich pond water in order to increase natural food production and to provide additional organic matter as fish food. The same author reported also that fish growth rate was found to be directly related to the amount of enrichment when ponds were low in nutrients. Hussein and Abdel-Hakim (2003) resulted that chicken manure and artificial feed remained the best tratments for maximum net marketable fish production. In the case of common carp, (Table 2) showed higher ($P<0.05$) final body weight (FW) (1259.66±2.60 g/fish) in T_1 than in T_2 (1217.0±1.15 g/fish) and in T_3 (1170.00±0.57 g/fish). No significant differences ($P>0.05$) was observed between T_1 and T_2 in total gain (TG), average daily gain (ADG) and total yield (TY). No significant differences were observed between treatments in total average daily gain (TADG). The reasonable explanation of low gain of common carp in T_3 compared with T_1 reported in similar studies indicates that either phytoplankton may not be enough to meet protein requirement of fish or that fish could not efficiently assimilate the produced phytoplankton in these ponds (Green, 1992, Diana *et al.*, 1994; Brown *et al.*, 2000). Similar finding were reported (Colman *et al.*, 1990) they noticed poor fish growth in fertilized concrete tank, and attributed it to the predomination of the green algae *Scenedesmus* and its poor assimilation. The growth responses of fish species in all the treatments were generally satisfactory because organic and inorganic fertilization were applied in the ponds, after that fish were fed at the last tow months on artificial feed beside the fertilization. So, it can be concluded that fish do not need to be fed immediately after stocking but can be supported by the natural food in the pond ecosystem (Abdelghany *et al.*, 2002). In this respect, Green (2006), reported that the addition of feed to ponds of common was necessary to maintain fast growth in addition to organic fertilization. Fish survival in all treatments were not significantly ($P>0.05$) affected by the treatments. Comparison of growth parameters among fish species in the present experiment was not possible due to differences in their initial size at stoking. Differences in growth performance and production (Table2) are likely due to the poultry manure fertilization level because all other factors that influence growth parameters were similar. Therefore, these results could provide technical guidance to farmers about organic fertilization practics that optimize fish growth and pond production.

Table 2: Growth performance, survival rate and total production for Nile tilapia, common carp, silver carp and garss carp as affected by different manuring levels.

Item	fish spp	T_1	T_2	T_3
Initial wt g/f	Nile tilapia	10.5±0.05^{a}	10.60±0.06^{a}	10.50±0.29^{a}
	silver carp	11.30±.0.05^{a}	11.2±0.06^{a}	11.10±0.03^{a}
	common carp	10.5±0.06^{a}	10.61±0.05^{a}	10.69±0.08^{a}
	grass carp	10.10±.0.35^{a}	10.19±0.10^{a}	10.28±0.12^{a}
Fw g/f	Nile tilapia	102.70±.0.15^{c}	114.46±0.88^{b}	122.26±0.88^{a}
	silver carp	864.00±1.15^{c}	931.66±1.76^{b}	1085.0±0.57^{a}
	common carp	1259.66±2.60^{a}	1217.0±1.15^{b}	1170.00±0.57^{c}
	grass carp	1297.00±1.15^{c}	1341.00±2.08^{b}	1433.33±1.76^{a}
TG kg/p	Nile tilapia	614.36±.0.57^{c}	702.2±1.88^{b}	727.8±1.78^{a}
	silver carp	247.17±0.95^{c}	265.62±0.66^{b}	303.05±0.88^{a}
	common carp	58.25±.0.23^{a}	5٦.77±0.28^{a}	54.64±0.28^{b}
	grass carp	59.34±.0.83^{c}	62.95±0.41^{b}	66.12±0.44^{a}
TADG kg/d/p	Nile tilapia	2.92±0.14^{a}	3.34±0.13^{a}	3.46±0.43^{a}
	silver carp	1.18±0.73^{b}	1.26±0.14^{b}	1.44±0.29^{a}
	common carp	0.28±0.11^{a}	0.2٧±0.14^{a}	0.26±0.23^{a}
	grass carp	0.27±0.14^{a}	0.29±0.2^{a}	0.31±0.34^{a}
ADG/fish g/d/f	Nile tilapia	0.43±0.11^{b}	0.49±0.12^{a}	0.52±0.15^{a}
	silver carp	4.05±0.08^{c}	4.22±0.29^{b}	5.11±0.26^{a}
	common carp	6.0٠±0.23^{a}	٥.74±0.37^{a}	5.52±0.12^{b}
	grass carp	6.12±0.12^{c}	6.33±0.31^{b}	6.77±0.32^{a}
Survival %	Nile tilapia	85.00±1.15^{a}	86.00±1.51^{a}	83.00±0.57^{a}
	silver carp	88.00±1.05^{a}	87.66±0.88^{a}	85.66±0.33^{a}
	common carp	93.33±0.88^{a}	93.00±0.69^{a}	94.33±0.9^{a}
	grass carp	92.29±0.35^{a}	94.66±0.86^{a}	93.00±1.15^{a}
Total yield kg/p	Nile tilapia	698.36±1.73^{c}	787.48±1.20^{b}	811.80±1.52^{a}
	silver carp	250.90±1.45^{c}	269.32±1.45^{b}	306.71±1.15^{a}
	common carp	58.78±0.66^{a}	56.00±0.57^{ab}	55.18±0.88^{b}
	grass carp	59.85±1.15^{b}	63.46±0.28^{a}	66.64±0.57^{a}

Economic efficiency:

Budget analysis results of the experiment are shown in Table 3. As shown in the table, production per feddan is increasing with increasing organic fertilization rate and reached 1241 in the third treatment. Also, average selling price increased with increasing organic fertilization rate reaching 6.41 L.E. /Kg. In the first treatment, average selling price was 5.84/Kg and average production per feddan was 1068 Kg resulting in total returns of 6237.12 L.E. The associated total costs were 4030 L.E.

per feddan. The most important variable costs items were feeding costs (1625 L.E.) representing 40.3% of total costs, followed by labor costs (900 L.E.) representing 22.3% of total costs, and fingerling costs (550 L.E.) representing 14.9 % of total costs. The rest of operating costs (organic and chemical fertilizers and pond maintenance) was estimated at 410 L.E representing 11 %. Fixed costs include only buildings and equipments depreciations that was estimated at 350 L.E representing 8.7% of total costs. An average net return per feddan was 2202.12 L.E /feddan.

The second treatment had an average selling price of 6.10/Kg and average production of 1180 Kg per feddan resulting in total returns of 7198 L.E. The associated total costs were 4425 L.E. per feddan. The most important variable costs items were feeding costs (1740 L.E.) representing 42.7 % of total variable costs, followed by labor costs (975 L.E.) representing 23.9% of total costs, and fingerling costs (550 L.E.) representing 13.5 % of total variable costs. The rest of operating costs (organic and chemical fertilizers and pond maintenance) was estimated at 810 L.E representing 19.9 % of total variable costs. Fixed costs include only buildings and equipments depreciations that was estimated at 350 L.E representing 7.9 % of total costs. An average net return per feddan was 2773 L.E /feddan.

Average selling price of 6.41/Kg and average production of 1241 Kg per feddan with total returns of 7954 L.E, were estimated for the third treatment. The associated total costs were 4825 L.E. per feddan. The most important variable costs items were feeding costs (1855 L.E.) representing 41.5 % of total variable costs, followed by labor costs (1050 L.E.) representing 23.5 % of total costs, and fingerling costs (550 L.E.) representing 12.32 % of total variable costs. The rest of operating costs (organic and chemical fertilizers and pond maintenance) was estimated at 1010 L.E representing 22.6 % of total variable costs. Fixed costs include only buildings and equipments depreciations that was estimated at 350 L.E representing 7.2 % of total costs. Average net return per feddan was 3129.8 L.E /feddan.

Table 3. Estimated Budget for Different Treatment of fish culture in one Feddan, Seven Month rearing period.

		First Treatment			Second Treatment			Third Treatment		
		Price	Quant	total	Price	Quantit	total	Price	Quantit	total
Total Returns										
Fish sales	Kg	5.84	1068	6237.12	6.1	1180	7198	6.41	1241	7954.8
Variable costs										
Fingerlings	Thou	50	11	550	50	11	550	50	11	550
Feed	Kg	2.50	650	1625	2.50	696	1740	2.50	742	1855
Organic fertilizers	Cub.	100	2	200	100	4	400	100	6	600
Phosphate Fertilizer	Kg	0.80	200	160	0.80	200	160	0.80	200	160
Urea fertilizers	Kg	1.50	100	150	1.50	100	150	1.50	100	150
Labor	Hr.	2	350	700	2	375	750	2	400	800
Labor (Technical)	Hr.	5	40	200	5	45	225	5	50	250
Pond Maintenance	Hr.	50	2	100	50	2	100	50	2	100
Total Variable Costs				3685			4075			4465
Fixed costs										
Depreciation				350			350			350
Total costs				4030			4425			4825
Net returns / Fedda				2202.2			2773			3129.8

According to Johns *et al.* (1981)

Table 4 shows performance indicators and break even analysis. It is clear that economic performance is getting better as one moves from the first to the second and then to the third treatment. One exception for the previous result was for labor productivity (Kg/hr.) since it was almost constant at 2.7. Second and third treatments require higher break even price or quantity because the higher production costs. Results indicated that production increased with increasing organic fertilization. Production reached 1241 kg when using 60 kg poultry manure/feddan/2week. Production decreased to 1180 kg when 40 kg of poultry manure were used and to 1068 kg when 20 kg of poultry manure were used / 2 week. Therefore, large quantity of poultry manure should be used with artificial feeding at the rate of 3 % of body weight if we want to produce more fish and biggest size. Average fish selling price were positively correlated with the quantities used of poultry manure. Therefore, it is recommended to use organic and chemical fertilization at the beginning of fish culture then using artificial feeding. Net returns per feddan were positively correlated with organic fertilization rates. Also, rate of return on investment was highest for highest organic fertilization rate. Break even price to cover total variable costs was estimated at 3.6 L.E. /kg when organic fertilization rates were at maximum (60 kg poultry manure/feddan/2week). This break even price represented about 56% of average selling price. Therefore, a producer can continue to work even if the price decreased by 44%. The break even quantity to cover total variable costs was estimated at 697 kg for the third treatment. Average production was 1241 kg/feddan. Therefore, break even quantity represents about 5٦% of average production. The previous results show that this type of production system can tolerate both production and price risk.

Table 4. Performance indicators of the treatments

	Treatment 1	Treatment 2	Treatment
Net returns (L.E./Fed)	2202.12	2773	3129.8
Production (Kg./Fed)	1068	1180	1241
Return on capital (%)	9	11	12.2
Pay back period(Yr)	3.6	3	2.8
Labor productivity (Kg/hr)	2.6	2.7	2.7
Labor productivity (L.E./hr)	16	17.1	17.7
Output input Ratio (%)	154	160	164
Return on operating capital (%)	169	176	178
Break even analysis			
Break even price to cover total costs (L.E/kg)	3.77	3.75	3.89
Break even price to cover variable costs (L.E/k	3.45	3.40	3.60
Break even quantity to cover total costs (kg)	٦90	725.4	752.7
Break even quantity to cover variable costs (kg	631	668	697

According to Kay (1981)

RECOMMENDATION:

Based on the obtained results morevere the cost of artificial fish feed and, the feeding behaviour of cultured species it can be concluded that fishes might be grow better on natural food throughout the early growing stages which reflect on saving the total price of production operation.

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تأثير برامج تسميدية مختلفة فى الاستزراع السمكى المتعدد على إنتاج الأسماك و قياسات جودة المياه و العائد الأقتصادى

صلاح محمد كمال[1] و جمال عزازى[2] و أشرف محمد سليمان[3]

١- قسم بحوث الاستزراع السمكى – المعمل المركزى لبحوث الثروة السمكية.

٢- قسم بحوث الأقتصاد السمكى – المعمل المركزى لبحوث الثروة السمكية.

٣- قسم بحوث الليمنولوجى – المعمل المركزى لبحوث الثروة السمكية.

الاستزراع المتعدد هو تربية أكثر من نوع سمك فى نفس الحوض و هى طريقة مضمونة لزيادة الأنتاجية بدون أى مصارف أضافية. فى نظام الاستزراع السمكى النصف مكثف استزراع السمك يعتمد على الغذاء الطبيعى الذى ينتج من خلال التسميد حتى حجم معين, وزيادة عن هذا الحجم تصبح الأغذية الأضافية ضرورية لتؤدى إلى أفضل نمو للأسماك. تسميد أحواض السمك يجب أن يكون بطريقة مثلى ومن هذه النقطة أجريت هذه الدراسة لإختبار مستويات مختلفة من التسميد العضوى (زرق الدواجن) فى الأحواض الترابية مع الاستزراع المتعدد للبلطى النيلى و المبروك الفضى و المبروك العادى و مبروك الحشائش. تم تسميد الأحواض فى الخمس شهور الأولى بالتسميد المعدنى و العضوى فقط. كان التسميد المعدنى ٥ كجم يوريا (٤٦,٥ % نيتروجين) و ١٥ كجم سوبر فوسفات (١٥,٥ % P_2O_5) للحوض كل أسبوعين بالتبادل مع التسميد العضوى. استخدم تسع أحواض ترابية مساحه كل حوض (واحد فدان) فى هذه الدراسة ووزعت إلى ثلاث معاملات وهى: T_1 (٢٠ كجم زرق دواجن/ حوض/ أسبوعين) و T_2 (٤٠ كجم زرق دواجن/ حوض/ أسبوعين) و T_3 (٦٠ كجم زرق دواجن/ حوض/ أسبوعين). تم تسكين الأسماك فى كل حوض بمعدل ١٠٠٠٠ أصباعية بلطى نيلى بمتوسط وزن (١٠,٥ جم/ سمكة) و ٣٠٠ إصباعية مبروك فضى بمتوسط وزن (١١,٢ جم/ سمكة) و ٥٠ إصباعية مبروك عادى بمتوسط وزن (١٠,٥ جم/ سمكة) و ٥٠ إصباعية مبروك حشائش بمتوسط وزن (١٠,٢ جم/ سمكة). تم تغذية الأسماك فى أخر شهرين على عليقة تجارية ٢٥% بروتين بمعدل ٣% من وزن الجسم ٦ أيام أسبوعيا.أختبار جودة المياه وضح أن ال pH و الملوحة والنيترات و النيتريت لم تتأثر معنويا بمعدل التسميد بينما الأكسجين الذائب ودرجة التوصيل الكهربى و المواد الكلية الذائبة الصلبة العسر الكلى و الأرثوفوسفات و النيتروجين العضوى زادت معنويا بزيادة مستويات التسميد. وقد اوضحت الدراسه أن متوسط قراءة قرص الشفافية قل معنويا عند مستويات التسميد العالى. محتوى كلوروفيل a كان مرتبط أيضا بمعدل التسميد العضوى. وأن أقصى نمو للبلطى النيلى و المبروك الفضى و مبروك الحشائش تم الحصول عليه عند معدل تسميد ٦٠ كجم زرق دواجن/ حوض/ أسبوعين (T_3). بينما كان أقصى نمو للمبروك العادى فى المعاملة T_1 (٢٠ كجم زرق دواجن/

حوض/ أسبوعين). أعلى أنتاج كلى للأسماك كان لمعدل تسميد ٦٠ كجم زرق دواجن/ حوض/ أسبوعين(T_3). و على الرغم من أن المعاملة T_3 سجلت أعلى تكاليف كلية إلا إنها سجلت أعلى صافي ربح وأعلى كفاءة أقتصادية وأيضا لها القدرة على تحمل المخاطرة فى الإنتاج والسعر.

وتوصى الدراسة بأن أفضل معدل تسميد بزرق الدواجن للأحواض الترابية المستزرع فيها البلطى النيلى و المبروك الفضى و المبروك العادى و مبروك الحشائش فى نظام الاستزراع المتعدد الأنواع هو ٦٠ كجم زرق دواجن/ حوض/ أسبوعين بالتبادل مع التسميد المعدنى، و التغذية على العلف التجارى فى أخر شهرين.