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EFFECT OF ORGANIC MANURES OR CHEMICAL FERTILIZERS ON WATER PARAMETERS AND GROWTH PERFORMANCE OF COMMON CARP (*Cyprinus carpio*) IN RICE FIELDS

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ABSTRACT

This study aimed to evaluate water parameters, the nutritive value, growth performance, fish productivity and economical efficiency of common carp (*Cyprinus carpio*) reared in rice fields that received weekly applications of nitrogen and phosphorus, at similar quantities, from three different sources. Nine rice fields (0.25 feddan each) were cultivated by rice and divided into three groups. The first group (T1) weekly received 150 kg total solid per feddan (Ts/fed.) of poultry manure, the second group (T2) weekly received 300 kg Ts/fed. of dairy cow manure, and in the third group (T3) 12.86 kg/fed. urea plus 26.3 kg/fed. triple super phosphate were applied weekly. All fields were stocked with common carp at a rate of 1500 fingerlings/fed. With an average weight of 2.21 g. The growing season for common carp fish was 90 days. The obtained results showed that treatment applied had significant effect on final body weight, specific growth rate, body length and condition factor of common carp. The highest survival rate was obtained with group of fish on T1 followed by T2 and T3 treatments, respectively. The highest net production was recorded at T1 followed by T2 and T3 treatments, respectively. The contents of dry matter decreased according to the different treatments while it was the reverse for the protein, fat and ash. Water quality was generally good in ponds fertilized with poultry manure than in ponds of other treatments. The highest net return was recorded with group of fish on T1 followed by T2 and T3 treatments, respectively. In general, the results of this study indicate that the organic nutrient sources were more productive than the inorganic ones but the difference in effectiveness of poultry and cow manures was surprising.

Keywords: Organic manure, Chemical fertilizers, Rice field, Common carp, Fish productivity, Proximate analysis, Economic efficiency.

INTRODUCTION

The concurrent cultures of rice and fish have many benefits over rice monoculture. One of these benefits is the increase in rice yield per unit area of cultivated rice. Lightfoot *et al.* (1992) summarized rice yield data from 20 rice–fish systems from China, India, Indonesia, Philippines and Thailand. They found that rice yield ranged from 58 to 183% as compared to rice monoculture. On average, the rice yield increased between + 0.6 to + 28.6 %. Moreover, Abdel–Hakim *et al.* (2000) found that the average body weight of Nile tilapia, *Oreochromis niloticus* cultured in rice fields has been increased from 4.08 to 81-97g and the rice yield increased by 148 kg/feddan, beside 77.0 kg fish/fedden. In Egypt, fish-rice system culture is promising for the development of rural areas. However, the total fish production in rice fields increased year by year and reached about 20,000 tons (GAFRD, 2001). The

development in fish-rice system culture needs more development in culture system managements especially in manure strategies.

Many investigations have shown positive correlation between pond fertilization and fish production in fish ponds (Schroeder, 1974 and Boyd, 1990). The increase in fish productivity in fertilized ponds has been attributed to an increase in primary production (Almazan and Boyd, 1978; Spataru *et al.*, 1983; Boyd, 1990; Diana *et al.*, 1991; El-Ayouty *et al.*, 1994 and Abdel-Tawwab *et al.*, 2002). Accordingly, increases in phytoplankton productivity with application of organic and/or inorganic fertilizers have been demonstrated (Spataru *et al.*, 1983; Ayouty *et al.*, 1994 and Abdel-Tawwab *et al.*, 2002). Phytoplankton growth in turn increases zooplankton production, thereby producing greater yields of fish (Stickney, 1979; Seymour, 1980 and Spataru *et al.*, 1983). The fish-rice system culture is similar to that of semi-intensive fish ponds. So, it is supposed that the application of organic and/or inorganic fertilizers to fish-rice system is so important for increasing the primary productivity in rice field's water, which will be turned to increase fish growth. Therefore, this study was conducted to investigate the effect of nitrogen and phosphorus, from poultry manure, dairy cow manure or chemical fertilizer, on the growth of common carp, *C. carpio* in rice fields.

MATERIALS AND METHODS

Location, facilities and fish:

The experiment was carried out in rice fields in AL-Salahat village, Bani-Ebied, Dakahlia Governorate, Egypt. The experiment as designed in this study was carried out of in used nine rice fields representing three treatments with three replicates per each. The individual rice field area was 0.25 feddan (34 x 30 m^2). Each area from all rice fields are prepared with an irrigation channel (zarouk) with diameters of 50-60 cm width and 40-50 cm depth with land long on one side of the field, where irrigation and drainage of this rice field was done through this zarouk. Giza rice 104 was used in this study. After 10 days from spender the rice and the up water level, the rice fields received fish fingerlings. The used fish was common carp (*Cyprinus carpio*). The fingerlings were obtained from Abbassa hatchery (General Authority for Fish Resources Development, Ministry of Agriculture) with an average weight of 2.21 g. The experiment was started on the 5th June and lasted on the 3rd September The rice fields were assigned randomly to on of the following treatments: The first group (T1) weekly received 150 kg total solid per feddan (Ts/fed.) of poultry manure, the second group (T2) weekly received 300 kg Ts/fed. of dairy cow manure, and in the third group (T3) 12.86 kg/fed. urea plus 26.3 kg/fed. triple super phosphate were applied weekly. All kind of fertilizers spread over water surface of the ponds. The chemical analyses of fertilizers used are summarized in Table (1).

Growth performance parameters:

Fish body weight and length of random sample of 30 fish from each treatment were taken at start and every two weeks, where the fish were netted from water and weighted to the nearest gram. Standard length of fish

was measured at beginning and at the end of the experimental period to the nearest cm then the fish were returned immediately to the zarouk. Growth parameters and condition factor were calculated as described in Ahmad *et al.* (2004).

Table (1): Nitrogen and phosphorus concentration (% dry matter), total solids (TS) and nutrient applications rates to rice fields stoked with common carp (*Cyprinus carpio*).

Nutrient source	Nitrogen (%)	Phosphorus (%)	TS (%)	Application rate (kg Ts/ fed./ week)	Nitrogen (kg/fed.)	Phosphorus (kg/fed.)
Poultry manure	2.75	2.46	83.3	150	53.63	47.97
Cow manure	1.46	0.55	21.3	300	56.94	21.45
Triple super phosphate	-	46.00		26.3	-	157.27
Urea	46.00	-		12.86	76.90	-

Proximate analysis :

The tested diets and fish from each treatment were chemically analyzed according to the standard methods of AOAC (1990) for moisture, protein, fat and ash. Moisture content was estimated by heating samples in an oven at 85 °C till constant weight for calculating weight loss. Nitrogen content was measured using a microkjeldah apparatus and crude protein was estimated by multiplying nitrogen content by 6.25. Total lipids content was determined by ether extraction for 16 hr. and ash was determined by combusting samples in a muffle furnace at 550 °C for 6 hr. Crude fiber was estimated according to Goering and Van Soest (1970).

Water and measurements:

Quality of pond water was checked once per month to determine temperature, dissolved oxygen (DO), Secchi disk visibility (SD), pH, free ammonia (NH_3), nitrite-nitrogen (NO_2-N), nitrate–nitrogen (NO_3-N), total alkalinity (T.alk), total phosphorus (TP), orthophosphate (OP) and chlorophyll 'a' (Chl-a). Temperature and dissolved oxygen were measured using thermo-oxygen meter (YSI model 57). All other measurements were carried out according to the standard methods of American Public Health Association (APHA, 1985) and Boyd (1984).

Statistical analysis:

The collected data were statistically analyzed by SAS program (SAS, 1987) and the differences among means were tested for significance according to Duncan's multiple rang tests as described by Duncan (1955).

RESULTS AND DISCUSSION

Chemical parameters:

Results of water parameters were summarized in Table (2). Water temperature at 7:00 A.M. ranged from 28.55 to 28.80 °C in all treatments during the study period. It is being adequate for fish growth and suitable for all chemical, physical and biological processes. Boyd (1990) reported that warm water species, which were native to temperate climates and best

semitropical, grow at temperature ranged between 20 and 28 °C. Also, all parameters of water quality are suitable to grow up fish. However, Hollerman and Boyd (1985) reported that supplemental organic and inorganic fertilized ponds gave a higher content of total nitrogen or total phosphorus, chlorophyll, primary productivity and fish production than organic fertilizer or chemical fertilizer only

Table (2): Effect of different treatments on different parameters of water quality.

Trea.	Temp. (°C)	DO (mg/L)	SD (cm)	pH	T.alk. (mg/L)	NH_3 (mg/L)	NO_2 (mg/L)	NO_3 (mg/L)	TP (mg/L)	PO_4 (mg/L)	Chl-a (mg/L)
T1	28.55	4.12	13.41	8.3	329.33	0.12	0.02	0.10	0.97	0.43	150.5
T2	28.80	3.0	14.74	8.5	399.33	0.17	0.02	0.15	0.69	0.33	127.6
T3	28.65	5.2	16.6	9.3	260.83	0.69	0.03	0.26	1.36	028	116.10

T1 = poultry manure, T2 = Cow manure, and T3 = inorganic fertilizers

Biological parameter plankton is comprised of all the microscopic organism whish are suspended in water and include phytoplankton and zooplankton. However, phytoplankton uses inorganic minerals, carbon dioxide available in water and sunlight to produce its own food. Zooplankton feeds on living or dead plankton, and other particles of organic matter found in the water. As in Table (3), the highest count of phytoplankton was obtained at treatments of poultry manure followed by cow manure and chemical fertilizers. Also, Boyd (1990) reported tnat the organic fertilizer might serve as a direct source of food for interprets food organisms and fish.

Table (3): Effect different treatments on concentration of plantation (organism/L) during the experimental period.

Treatments		T1	T2	T3
Plankton	Division			
Phytoplankton	Green algae	185	156	117
	Blue green algae	122	107	92
	Euglena	24	21	8
	Diatoms	8	7	6
Zooclankton	Copepoda	216	183	102
	Rotifera	36	30	20
	Cladocera	24	20	8
	Ostracode	13	11	5

Growth performance:

The results showed that all treatments of fish gave satisfactory growth during the experimental period as indicated by the progressive live body weight increase with age advancement. As described in Table (4), the average body weight of common carp was increased from 2.21 g to 191.48, 157.50 and 141.58 g for T1, T2 and T3, respectively. Also, averages of daily gain were 2.10, 1.72 and 1.55 g for T1, T2 and T3, respectively. The highest average final body weight and daily gain were observed for poultry manure treatment followed by cow manure, while the chemical fertilizers treatment exhibited the lowest values. The difference among the three treatments were found to be significant ($P<0.05$). On the other hand, the fish yield at different

treatments was difference significantly (P<0.05). The poultry manure treatment showed better yield (278.41 kg/fed.) than others (Table 4).

This results are in partial agreement with the finding of Diana *et al.* (1991) who reported that net fish yield was higher in organically than inorganically fertilized ponds in spite of similar primary production and chlorophyll 'a' concentration. Green *et al.* (1989) found that the mean net fish production was the greatest in chicken litter treatment (1759 kg/ha/150 days) , and cow manure (1295 kg /ha/150 days) or chemical fertilizer (1194 kg/ha/150 days). This probably resulted from increased heterotrophic production (Schroeder 1975, 1978) or direct consumption of manure (Popma, 1982). In this connection, Salama (2003) reported that under the integrated rice-fish system the body weight of Nile tilapia increased from 30.12 to 78.13 during 90 days rice-fish culture period.

Table (4): Effect of manure's and chemical fertilizers on growth parameters of common carp (*Cyprinus carpio*).

Parameter	Treatments		
	T1	T2	T3
Initial body weight/fish (g)	2.21 ± 0.09^{a}	2.21 ± 0.09^{a}	2.21 ± 0.09^{a}
Initial body length/fish(cm)	5.01 ± 0.12^{a}	5.01 ± 0.12^{a}	5.01 ± 0.12^{a}
Final body weight/fish (g)	191.48 ± 6.73^{a}	157.50 ± 6.32^{b}	141.58 ± 6.82^{c}
Final body length/fish(m)	25.23 ± 0.27^{a}	23.45 ± 0.44^{b}	20.40 ± 0.39^{c}
Body weight gain (g)	189.27 ± 0.55^{a}	155.79 ± 0.30^{b}	139.37 ± 0.51^{c}
Daily weight gain (g)	2.10 ± 0.001^{a}	1.72 ± 0.074^{b}	1.55 ± 0.35^{c}
Specific growth rate	4.95 ± 0.85^{a}	4.74 ± 0.05^{b}	4.62 ± 0.05^{c}
Relative growth rate	8564.25 ± 0.27^{a}	7026.70 ± 0.81^{b}	6306.33 ± 0.43^{c}
Condition factor	1.19 ± 0.17^{a}	1.22 ± 0.07^{b}	1.67 ± 0.03^{c}
Fish survival (%)	96.9 ± 0.21^{a}	95.7 ± 0.18^{b}	93.6 ± 0.07^{c}
Yield (kg/feddan)	278.41 ± 11.38^{a}	226.17 ± 10.08^{b}	198.77 ± 9.67^{c}

^{a} – ^{c} **Means in same row having the same superscript letters are not significant different (P>0.05). T1 = poultry manure, T2 = Cow manure, and T3 = inorganic fertilizer**

Condition factor (K):

Measuring the increase of fish weight and length could readily monitor fish growth. Another parameters, which may be used as index of growth is the condition factor, which provides a measure of fatness of fish and food conversion efficiency (Power, 1990). The K factor also measures the plumpness or robustness of fish and is easily calculated from routinely collected length weight data. Condition factor is frequently assumed to reflect not only characteristics of fish such as health, reproductive state and growth, but also characteristics of environment such as habitual quality, water quality and prey availability (Liao *et al.* 1995). The average of K values at the end of the experimental period for T1, T2 and T3 were found to be 1.19, 1.22 and 1.67, respectively (Table 4). The statically analysis of the results showed that the chemical fertilizers group had significantly (P<0.05) the highest K value followed by cow manure and poultry manure, respectively. Increased K factors with the size of rations have been reported by Chua and Teng (1982). Dioundick and Stom (1990) demonstrated that for *O. mossambicus*, the

values of K factor decreased by increasing the α-cellulose presented from 0% to 10% of the diet.

Survival:

Fish survival rates in T1, T2 and T3 during the whole experiment period were found to be 96.9%, 95.7% and 93.6%, respectively (Table 4). Analysis of variance showed that the differences in survival among treatments were significant ($P<0.05$). Results in this respect are in agreement with the finding of Green *et al.* (1989) who found that fish survival was 94.8%, 93.7% and 92.6% for the layer chicken litter, dairy cow manure and inorganic fertilizer. Also, Perez-Athanasiad and Bellido-decedeno (1989) obtained 90% survival rate for Nile tilapia in rice culture fields.

Chemical composition of the whole fish:

Averages of crude protein (CP), total fat (EE), ash, dry matter and moisture in the whole fish body for different treatments at the end of the experimental are illustrated in Table (5). The obtained results indicated that the chemical fertilizer treatment showed higher ash and protein contents, but it caused lower fat content. Thus, it could be started that there is a negative correlation between ash or protein content and fat content. Dry matter percent in whole fish did not affect significantly. In this respect, Hafez *et al.* (2000) observed that manuring level of silver carp influenced the whole fish contents of crude protein. Also Moav *et al.* (1977) indicated that total body fat content of the common carp was 20%, 15% and 6%, when fed with high protein pellets, grain pellets or reared on liquid cow manure, respectively.

Table (5): Chemical composition (on dry matter basis) of the whole fish of common carp (*Cyprinus carpio*) reared in rice filed at the end of the experimental period.

	Moisture (%)	Dry matter (%)	Crude Protein (%)	Fat (%)	Ash (%)
T1	78.32 ± 0.05 ^{b}	21.67 ± 0.05 ^{a}	69.80 ± 1.12 ^{c}	19.01 ± 0.60 ^{a}	11.019 ± 0.95 ^{c}
T2	79.72 ± 0.33 ^{a}	20.72 ± 0.33 ^{a}	70.81 ± 0.07 ^{b}	15.72 ± 0.53 ^{b}	13.74 ± 0.48 ^{b}
T3	79.09 ± 0.38 ^{a}	20.31 ± 0.38 ^{a}	72.37 ± 0.27 ^{a}	12.09 ± 0.05 ^{c}	15.54 ± 0.35 ^{a}

^{a} - ^{c} Means in same row having the same superscript letters are not significant different ($P>0.05$). T1 = poultry manure, T2 = Cow manure, and T3 = inorganic fertilizer

Economic Efficiency:

As a presented in Table (6), results of total costs including the variable and fixed costs for treatment found to be 355, 416 and 484.08 LE/fed for treatments of poultry manure, cow manure and chemical fertilizers, respectively. The results revealed that the total cost of the field treatment with chemical fertilizer were the highest due to the low total quantity of fish as kg and cost of feed from urea, triple superphosphate. From Table (6), the net returns were 745.4, 481.44 and 297.76 LE/fed., respectively. The results showing that the treatment of poultry manure is the best from the point of view of economic efficiency. This result is partially agreed with Viola and Zohar (1984).

Table (6): The economical data per feddan on fish production in L.E.

Description	Unit	Price	T1		T2		T3	
			Quan.	Value	Quan.	Value	Quan.	Value
Total return Cost feddan	k.g	4.00	275.10	1100.40	222.86	891.44	195.46	781.64
Finger lings	1000	30.0	1.50	45.00	1.50	45.00	1.50	45.00
Poultry manure	M3	40 0	4.50	180.0	-	-	-	-
Cow manure	M3	25.00	-	-	9 00	225.00	-	-
Triple super chosphate	Bag	35	-	-	-	-	6.312	220.92
Urea	Bag	30	-	-	-	-	3.072	92 16
Labor	hr	2.00	15 00	30.00	20.00	40.00	13.00	26.00
Irrigation water	Hr	2.50	12.00	30.00	12.00	30 00	12.00	30.00
Ditch dig	Mz	50.00	100.00	50.00	100.00	50.00	100.00	50.00
Screen	Unit	10.00	2.00	20.00	2.00	20.00	2 00	20.00
Total costs	-	-	-	355.0	-	416.0	-	484.08
Net return	-	-	-	745.4	-	481.44	-	297.76
E E.	-	-	-	209.97	-	117.42	-	61.51

E.E. = Net return per fed / total costs per fed X 100.
T1 = poultry manure., T2 = Cow manure and T3 = inorganic fertilizer

Conclusion:

In general. the results of this study indicated that the organic nutrient sources were more productive under three experimental conditions than the inorganic sources but the difference in effectiveness of poultry and cow manures was surprising.

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تأثير السماد العضوي والمعدني على جودة الماء و أداء النمو لسمكة المبروك العادي في حقول الأرز

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قسم الاستزراع السمكي بالمعمل المركزي لبحوث الثروة السمكية – محافظة الشرقية .

*** قسم تغذية الأسماك بالمعمل المركزي لبحوث الثروة السمكية – محافظة الشرقية.**

أجريت هذه التجربة لدراسة جودة الماء والقيمة الغذائية ومعدلات النمو والإنتاجية الكلية والكفاءة الاقتصادية لسمكة المبروك العادي المربأة في حقول الأرز عند إضافة كميات متساوية أسبوعيا من النيتروجين والفسفور من ثلاث مصادر مختلفة. استخدم تسعة حقول مساحة الحقل الواحد ٠,٢٥ فدان زرعت بالأرز و قسمت إلى ثلاث مجموعات . المجموعة الأولى استخدمت فيها سبلة الدواجن الجافة بمعدل ١٥٠ كجم لكل فدان أسبوعيا إما المجموعة الثانية فاستخدمت السبلة الجافة للماشية بمعدل ٣٠٠ كجم لكل فدان أسبوعيا والمجموعة الثالثة استخدم فيها السماد غير العضوي ممثلا في اليوريا بمعدل ١٢,٨٦ كجم لكل فدان أسبوعيا بالإضافة إلى سماد السوبر فوسفات الثلاثي بمعدل ٢٦,٣٠ كجم لكل فدان أسبوعيا. تم تسكين سمكة المبروك العادي في كل الأحواض بمعدل ١٥٠٠ سمكة للفدان بوزن اولي ٢,٢١ جم وقد استغرقت التجربة مدة ٩٠ يوما. أظهرت النتائج أن جودة مياه حقول الأرز كانت أفضل بصفة عامة في الحقول المسمدة بسبلة الدواجن عنها في الحقول الأخرى. أتضح أن مقاييس الجسم (وزن – طول) قد زادت باستخدام التسميد بسبله الدواجن كما أن الأسماك التي سمدت أحواضها بالسبله الجافة للماشية قد أظهرت فيما اكبر ليذه المقاييس مقارنة بتلك التي حصلنا عليها باستخدام التسميد غير العضوي وكانت الفروق بين المعاملات الغذائية ذات دلالة إحصائية. أظهرت النتائج أن أعلى معدل إعاشة تم الحصول عليه في المجموعة الأولى (سبلة الدواجن) تليها المجموعة الثانية (سبلة الماشية) ثم المجموعة الثالثة (التسميد غير عضوي) على التوالي. كما أظهرت النتائج زيادة الإنتاج الكلي من الأسماك للمعاملة الأولى (سبلة الدواجن) يليها المعاملة الثانية (سبلة البقر) ثم الثالثة (التسميد الغير عضوي) على التوالي. انخفض محتوى جسم السمكة من البروتين والمادة الجافة باختلاف المعاملات المستخدمة. بينما كان هناك اتجاها معاكسا لمحتوى الدهن والرماد. كما أظهرت النتائج إلى وجود زيادة ملحوظة للعائد الصافي لأسماك المعاملة الأولى (سبلة الدواجن) يليها اسماك المعاملات الثانية (سبلة الماشية) والثالثة (التسميد غير العضوي) على التوالي. بصفة عامة فقد أشارت نتائج هذه الدراسة أن مصادر المخصبات العضوية كانت أكثر إنتاجية من مصادر المخصبات غير العضوية ، لكن الاختلافات في كفاءة السبلتين (سبلة الدواجن والسبلة الجافة للماشية) كانت ملحوظة .