JOURNAL OF THE
ARABIAN AQUACULTURE SOCIETY

Vol. 8 No 3 **December 2013**

Fertilization and Culture System - Influence on Organic Matter, Nitrogen and Phosphorus Dynamics in Different Soils of Nile Tilapia, *Oreochromis niloticus*, Ponds

Sallam, G. [2*], Fayed, W.[1], El-Zaeem, S. [1], El-Dahhar, A. A.[1], Salama, M.[1]
[1] Department of Animal and Fish Production, Faculty of Agriculture (Saba Basha), Alexandria University, Alexandria, Egypt
[2] National Institute of Oceanography and Fisheries (NIOF), Alexandria, Egypt

*****Corresponding Author

ABSTRACT

Three different fish farms were studied for their soil type according to their organic matter, nitrogen and phosphorus dynamics from fertilized and unfertilized ponds with two culture systems. The pond soils were clayey, clay-sandy, and sandy in three different locations in Egypt. The fish ponds were fertilized with organic fertilizers (compost) and inorganic fertilizers (nitrogen: phosphorus with ratio of 4:1, 500:14 kg/feddan/week, respectively. Nile tilapia, *Oreochromis niloticus*, was reared with mean initial body weight of (5.31g) in monoculture system with density of 22,000 fish/feddan, and with grey mullet *Mugil cephalus,* mean initial body weight of 9.88g in polyculture system. Fish were fed commercial diet (25% crude protein) for 240 days. The results revealed that organic matter (OM), nitrogen (N) and phosphorus (P) increased gradually for all treatments throughout the experimental period. However, the OM, N and P were significantly *(P<0.05)* affected with soil type in the three studied locations. Also, the values of these parameters for fertilized ponds were significantly higher than unfertilized ponds for the three soil types of the studied locations. The same pattern was observed for polyculture system results when compared to monoculture especially in sandy soil. Thus, the results indicated that fertilization was more effective in sandy soil than clay-sandy or clay soil. Correspondingly, regardless to location and culture system fertilized ponds were higher in final yield than unfertilized ponds, and also polyculture system was better than monoculture regardless to location and fertilization.

Keywords: Organic matter, nitrogen, phosphorus, fertilization, monoculture, polyculture, Nile tilapia, and grey mullet.

INTRODUCTION

Soil quality is defined as "the capacity of a soil to function within ecosystem boundaries to sustain biological productivity, maintain environmental health, and promote plant and animal health" (Boyd 1995). The soil condition is an important environmental factor influencing water quality and controlling various process (Avnimelech and Ritvo 2003; Ntengwe and Edema 2008). However, the major chemical factors of importance are the pH, nitrogen, phosphorus, organic carbon, C/N ratio, calcium and potassium (Hickling 1971)**.** Banerjea (1967) classified pond productivity into three categories – low, medium and high based on the availability of nitrogen, phosphorus and organic carbon.

Physio-chemical parameters of water which govern the biological production are to a large extent a reflection of the bottom soil. To some extent, bottom soil of ponds control the naturally available food chain in the ponds. The most reactive fraction of soil is comprised of small particles of clay that offers large surface for adsorption and ion exchange (Boyd 1995). The soil with a majority of clayey-sized particles could bind water and nutrients tightly, and is often sticky and difficult to till. A sandy soil will not retain much water and has a small capacity to adsorb and hold nutrients. A loamy soil is intermediate between the two extremes. Loam has a greater capacity to absorb water and nutrients than a sandy soil, but the water and nutrients are not held as tight as by clayey soil. Moreover, pond soil must contain 20-30% clay-sized particles to prevent seepage, but clayey-loam soil is generally better for fish production than heavy clay soil (Boyd 1995). Thunjai (2002) reported that bottom soil of pond has its effect on production and plays an important role in influencing production of fish pond.

The pond bottom plays an important and dynamic role in the production of fish (Munsiri et al. 1996). A significant correlation between production of fish and soil types of ponds was observed when the effect of pond soil on fish production was studied in a wide variation of soil types with respect to their fish productivity (Bagghi et al. 1990). Some researches confirmed that, phosphorus are limiting factor of production in temperate ponds (Boyd 1990). Others stated that, higher yields can be achieved with adding nitrogen and phosphorus in subtropical or tropical ponds (Boyd 1976). Thus, organic fertilizer has been used to improve pond productivity for the culture of several species and stimulate the development of heterotrophs (bacteria), autotrophs (algae) and other food organism to increase fish production in ponds (Schroeder et al. 1990; Wurts 2004).

Chemical fertilizers of fish ponds stimulate phytoplankton production which increases fish yields. They contain inert filler material mixed with three important minerals, nitrogen (N), phosphorous (as P_2O_5) and potassium (as K_2O) which are needed by phytoplankton in fish ponds. Although, fertilizers high in phosphorous trigger phytoplankton production in freshwater ponds (Goldman 1983), but nitrogen is require for novel freshwater ponds and salt-water ponds (Boyd 1990).

The actual requirement of fertilizer dose in a pond system may vary depending upon the type of fish farming, environmental condition and productive history or the residual nutrients in the bottom sediment of the fish ponds. Furthermore, fertilizer requirements may vary between earthen ponds and experimental concrete tanks due to the more leaching capacity of bottom soil in the former than the latter (Bhakta et al. 2004).

Nile tilapia *O. niloticus* is commonly grown in fertilized ponds to increase primary and secondary production. For maximizing tilapia production in polyculture systems, it is necessary to fully understand relationships between fish and the surrounding environment. Understanding such complicated relationships will enable fish farmers and farm managers to select suitable species, sizes, stocking densities, fertilization regimes, nutritional inputs and other management practices. The culture of fish species that have different feeding habits in the same pond will result in more efficient utilization of pond resources, and high production efficiency (Milstein 1997). However, the production of tilapia with other fish or crustacean species in a polyculture system is spreading widely in many parts of the world. It is believed that this system results in a higher net yield than monoculture system, due to the full exploitation of multiple niches. Yet there is a little evidence to support this argument, except for the polyculture of fishes that are characterized by selective feeding habits, such as Chinese carp and common carp. The culture of fish species that have different feeding habits in the same pond will result in more efficient utilization of pond resources. If different feeding niches are used in such a way that the wastes of one species are used as food for another, higher production efficiency is expected to be achieved (Milstein, 1997). The objective of the present study is to determine correlation between soil type (clayey, clay-sandy, and sandy) and quality on total Nile tilapia, *Oreochromis niloticus*, yields with (organic and inorganic fertilizers) or without adding fertilization along with applying two different culture systems (monoculture and polyculture) in Egypt.

MATERIALS AND METHODS

Experimental facilities

The study has been applied for 8 months from the 15th of April 2004 through the 10th of December 2004 at three private commercial fish farms different in their OM, nitrogen, and phosphorus contents. Two of which were at Behaira governorate (Edko (E), and Kafr Eldawar (K))the third private fish farm at the city of Borg El-Arab (B), Alexandria governorate. Thus, twelve treatments were formed for the three locations varied in types of soil (Table 1), each location has four treatments (monoculture and polyculture system; fertilized and unfertilized). Each treatment has its own replicate forming a total of eight ponds in each location. Water quality and soil analysis, and fish measurements were performed monthly at all locations.

Ponds

Earthen ponds used were with surface area of one feddan each, and with average depth of one meter. The initial preparation maintenance was applied to all ponds throughout the experimental period. The water exchange rate of 5%, 10%, 15%, and 20% of the total water volume for the first two months, then the second two months, followed by the third two months, and then for the rest of the experimental period, respectively.

Experimental fish and diet

Hormonal treated sex-reversed all male Nile tilapia fingerlings were obtained from a private farm in Edko, Behaira Governorate. The stocking density in all monoculture system ponds was 22,000 *O. niloticus* fish/ feddan, and 20,000 Nile tilapia along with 2000 grey mullet, *Mugil cephalus* for polyculture system. Initial average body weight (BW) for *O. niloticus* was 5.31±0.03 g/fish, and that for *Mugil cephalus* was 9.66±0.06. A commercial pelleted feed (25% crude protein) was introduced to satiation three times a daily six days a week.

Table 1. ***Sediment logical components and main values of pH, Calcium carbonate ($CaCO_3$) and salinity surface layer (0-30cm) of the different soils in the studied locations.***

Location	Sediment Component						
	Sediment type	Sand (%)	Silt (%)	Clay (%)	pH	$CaCO_3$	Salinity
Edco	Clayey	36.25	13.50	40.00	8.30	6.85	0.23
Kafr El-Dawar	Sandy clay (Loamy)	58.35	10.00	26.50	8.00	5.70	0.40
Borg El-Arab	Sandy	70.69	10.00	12.00	7.69	2.45	0.58

Organic and chemical fertilization

Compost was used as organic fertilizer obtained from the Agricultural administration of Kafr Eldawar, Beheira governorate, was applied at a rate of 500 kg/feddan/ week. Urea (with N content of 46.5%) and mono-super phosphate (with P content of 15.5%) were applied as chemical fertilizers at a rate of 2.8 grams of (N) and 0.7 grams of phosphorus (P) /m^2 to bring the ratio of 4: 1 for N : P (Yi and Lin 2001).

Statistical analysis

Statistical analyses were conducted using methods from SYSTAT: the system for statistics as described by Wilkinson (1990). The analysis of variance (ANOVA) and least significant differences test were conducted according to Snedecor and Cochran (1981).

RESULTS

Soil quality

The results showed (Table 2) that organic carbon (OC) increased gradually in all treatments of the three studied locations throughout the experimental period. However, the OC was clearly affected by the studied location as the presence of OC in soil was significantly different (P<0.05) among all treatments. (E) recorded the highest in OC, followed by (K), and then by (B) with mean values of (2.08±0.77), (1.58±0.45), and (0.61±0.36), respectively. Moreover, fertilization significantly (P<0.05) increased the OC from (1.26±0.92) with (U) ponds to (1.95±0.92) in (F) ponds. In addition, the type of culture system significantly increased (P<0.05) the availability of OC in pond soils from (1.03±0.45) for (P) to (1.82±0.72) for (M). That might be because of the presence of grey mullets in polyculture system, which consumes OC found in pond soils. Statistical analysis showed that there were no significant difference between (EUM), (KFM), and (KUM). However, significant differences were found between (EUP), (KFP), (KUP), and (BFM), also between (BFP) and (BUP).

Total and available nitrogen (N)

The total nitrogen increased gradually in all treatments as a general trend. However, location showed a remarkable effect on total nitrogen, where (E) and (K) were significantly higher (P<0.05) than (B) in total N available in soil with values of 147.41±15.55, 143.10±24.56, and 61.34±9.11mg/100g, respectively. Consequently, fertilization showed that it had an obvious effect on the total (N) of soil. As a results, total nitrogen increased significantly (P<0.05) from 105.20±8.96 to 128.69±13.40 mg/100g in fertilized ponds when compared to unfertilized ponds, respectively. Similarly, culture system greatly affected the total (N) of soils, where monoculture system showed significantly (P<0.05) higher total nitrogen more than polyculture system with mean values of 135.54±10.12 and 99.02±10.02 mg/100g, respectively. A significant (P<0.05) interaction was encountered between location, fertilization, and culture system on total N in soil. The highest total N in soil was observed in (EFM) (178.88±12.23 mg/100g) followed by (KFM) (158.50±9.95 mg/100g), (EFP and KFP) (149.13±15.55 and 148.13±14.14 mg/100g) respectively, (KUM) (144.50±11.66 mg/100g), (BFM) (139.50± 655 mg/100g), (EUM), (138.75±11.34 mg/100g), (BFP), (123.13±13.88 mg/100g), (EUP), (119.88 ±13.12 mg/100g), while, the lowest observed in the (BUM and BUP), (55.13±6.56 and 50.75±14.03 mg/100g), respectively. However, no significant differences was observed between (EFP), (KFP) and (KUM); and also, between (BFM) and (EUM), between (BFP), (EUP), (KUP) and between (BUM) and (BUP).

The available nitrogen was significant higher for (E) and (K) than (B) with mean values of 13.81±1.06, 11.20±1.19 and 5.76±0.04 mg/100g, respectively. In addition, the results showed that fertilization, affected greatly the

Table 2. ***Organic carbon (OC), total nitrogen (mg/100gm), available nitrogen (mg/100g), and carbon to nitrogen ratios (in weight), total phosphorus and available phosphorus of soil samples from the three studied locations (E, K and B) of the study.***

Location	**F**	**S**	O.C (C %)	T N (mg/100g)	A N (mg/100g)	C/N Ratio	T P (mg/100g)	A P (mg/100g)
E	+	**M**	3.10±0.00[a]	178.88±12.23[a]	17.71±1.03[a]	17.33±1.43[a]	43.24±3.02[a]	1.69±0.07 [a]
		P	1.52±0.01[c]	149.13±15.55[c]	15.33±2.12[a]	10.19±0.95[bc]	35.07±4.50[b]	1.40±0.05 [b]
	-	**M**	2.24±0.01[b]	138.75±11.34[d]	12.03±0.88[bc]	16.19±0.55[a]	27.58±3.11[c]	1.14±0.00 [c]
		P	1.45±0.00[cd]	119.88±13.12[e]	10.16±1.40[cd]	11.80±1.70[b]	23.97±6.13[c]	1.30±0.01 [b]
K	+	**M**	2.10±0.01[b]	158.50±9.95[b]	13.52±1.06[b]	13.25±1.35[b]	38.92±3.55[b]	1.27±0.02 [bc]
		P	1.29±0.01[d]	148.13±14.44[c]	11.03±1.32[c]	8.71±0.95[c]	35.88±7.02[b]	1.12±0.02 [c]
	-	**M**	1.74±0.01[bc]	144.50±11.66[c]	11.24±0.78[c]	12.04±1.10[b]	27.15±4.56[c]	0.78±0.00 [d]
		P	1.20±0.00[d]	123.25±8.95[e]	9.01±0.97[d]	9.74±1.34[c]	24.06±4.11[c]	0.63±0.01 [d]
B	+	**M**	1.15±0.01[d]	139.50±6.55[d]	11.33±0.06[c]	8.24±1.70[c]	32.25±2.11[b]	0.84±0.03 [d]
		P	0.39±0.01[f]	123.13±13.88[e]	10.88±0.71[c]	3.17±0.5[f]	26.48±9.11[c]	0.69±0.02 [d]
	-	**M**	0.60±0.01[e]	55.13±6.56[f]	0.45±0.04[e]	10.88±1.10[bc]	9.19±2.12 [d]	0.42±0.01 [e]
		P	0.32±0.01[f]	50.75±14.03[f]	0.40±1.03[e]	6.31±0.50[e]	7.88±3.11[d]	0.41±0.02[e]
					Pooled Means			
E			2.08±0.77[l]	147.41±15.55[l]	13.81±1.06[l]	13.88±3.43 [l]	32.47±4.15[l]	1.38±0.02 [l]
K			1.58±0.45[m]	143.10±14.56[l]	11.20±1.19[l]	10.93±1.88[m]	31.50±5.33[l]	0.9±0.01 [m]
B			0.61±0.36 [n]	61.34±9.11[m]	5.76±0.04[m]	7.15±±1.98 [n]	18.95±3.56[m]	0.59±0.04 [n]
	+		1.95±0.92 [s]	128.69±13.40[s]	13.3±1.01[s]	10.15±4.81 [s]	35.31±3.65 [s]	1.17±0.03 [s]
	-		1.26±0.70 [t]	105.20±8.90[t]	7.19±0.63[t]	11.16±3.90 [s]	19.97±3.44 [t]	0.78±0.02 [t]
		M	1.82±0.72[x]	135.54±12.66[x]	11.55±1.33[x]	12.99±3.84 [x]	29.72±6.07[x]	1.02±0.04 [x]
		P	1.03±0.45[y]	99.02±10.12[y]	9.47±1.04[y]	8.32±3.11 [y]	25.56±5.12[x]	0.92±0.01 [x]

Means having different letters within column in a main effect are significantly different (P≤0.05).

available nitrogen in soil. The (F) ponds were significantly higher (P<0.05) than (U) pond in available nitrogen with mean values of 13.30±1.01 and 7.19±0.04 mg/100g, respectively. The results revealed that available N decreased significantly from 11.55±1.33 mg/100g in (M) to 9.47±0.69 mg/100g in (P) indicating that there was a significant interaction between types of soil (location), fertilization, and culture system on available N in soil. The highest values of available N were recorded in (EFM) and (EFP) (17.71± 1.03 and 15.33± 2.12 mg/100g) respectively with no significant differences, the same trend was observed between (KFM and EUM), (BFM), (KUM), (KFP), (BFP), (EUP), and (KUP). Also, no significant differences observed between (EUP) and (KUP) with values of (10.16 ±1.40 and 9.01± 0.97 mg/100g), (0.45±0.04 and 0.40±0.03 mg/100g), respectively.

Total and available phosphorus

With respect to total phosphorus in soil mg/100g (Table 3), statistical analysis did not reveal any significant differences between E and K total P in soil but value of B was significantly low with values of 32.47±4.15, 31.50±5.33 and 18.95±3.36 mg/100g, respectively. Also, total P in soil was directly proportion to fertilizers, it increased significantly (P<0.05) from 19.97±3.44 for U to 35.31±3.65 mg/100g for F ponds. However, for culture system the results revealed that total P decreased insignificantly from 29.72±6.07 in MS to 25.56±5.12 mg/100g in PS. Results for total P showed that there was a significant difference (P<0.05) between treatments, the highest value was recorded in EFM (43.24±3.02 mg/100g) followed by KFM (38.92 3.55), KFP and EFP (35.88±7.02 and 35.07±4.50 mg/100g), BFM (32.25±2.11 mg/100g), EUM and KUM (27.58±3.11) and (27.15± 4.56), BFM (26.48±9.11), KUP and EUP (24.06±4.11 and 23.97± 6.13), and BUM, BUP (9.19±2.12 and 7.88±3.11 mg/100g), respectively. The statistical analysis for total P for (KFM and KFP, EFP and BFM, also between EUM, KUP and BUM, BUP) did not reveal any significant differences. However, results of available P showed that there were significant differences (P<0.05) between locations as it decreased significantly from 1.38±0.02 in E to 0.90±0.01 in K and the lowest value was observed in B 0.59±0.04. Also, a positive correlation between fertilizer and available P in soil was observed between treatments, it increased significantly (P<0.05) from 1.17±0.03 to 0.78±0.02 for U and F ponds, respectively, and decreased with no significant difference from 1.02±0.04 for M to 0.92±0.01 for P. Moreover, the results of available P showed that there were significant differences (P<0.05) between treatments, the highest value was recorded for EFM (1.69± 0.07) followed by EFP, EUP (1.40±0.05 and 1.30±0.01 mg/100g), KFM, EUM (1.27±0.02 and KUP (0.69±0.02 and 0.63±0.01 mg/100g), and the lowest values were for BUM, BUP (0.42± 0.01 and 0.41±0.02 mg/100g) respectively. However, statistical analysis revealed that there were no significant differences between EFP, EUP and KFM, also between KFM, KFP and EUM, EUP and EUM, BFM, BFP and KUM, KUP and between BUM and BUP.

Carbon to nitrogen ratio (C: N)

C:N ratio significantly decreased from 13.88±3.43 for (E) to 10.93±1.88 for (K) and the lowest value was found in (B) with value of 7.15±1.98. On the other hand, there were no significant differences of C: N ratio with adding fertilizes, where C:N ratio increased from 10.15±4.81 with using (F) to 11.16±3.90 with (U) ponds. On the contrary, culture system results showed that C: N ratio decreased significantly (P<0.05) from 12.99±3.84 in (M) to 8.32±3.11 in (P).

The relation between location, fertilization, and culture system on C: N showed a significant (P<0.05) effect. The highest average value of C:N ratio was recorded for (EFM and EUM), it was 17.33±1.43 and 16.19±0.55 followed by KFM (13.25±1.35) and KUM (12.04 ±1.10), EUP (11.80 ±1.7), (BUM

Table 3. Mean values of initial biomass, total yield, net yield and survival % for Nile tilapia and Grey mullet reared at three different locations fertilized and unfertilized ponds cultured with mono and polyculture system in the first experiment.

Location	F	C.S	Initial biomass (kg/feddan)		Total yield (kg/feddan)		Net yield (Kg/feddan)		Survival%	
			Nile tilapia	Mullet Sp	Nile tilapia	Mullet Sp	Nile tilapia	Mullet Sp	Nile tilapia	Mullet Sp
E	+	M	116.82	00.00	4905.55 ^{a}	00.00	4788.73 ^{a}	0000.00	82.45 ^{a}	00.00
		P	106.20	19.76	4545.17 ^{a}	1396.31 ^{a}	4438.97 a	1376.55 a	83.44 ^{a}	90.55 ^{a}
	-	M	116.82	00.00	4800.12 ^{a}	00.00	4683.94 a	0000.00	80.11 ^{a}	00.00
		P	106.20	19.76	4549.74 ^{a}	1045.67 ^{b}	4443.54 a	1025.91 b	83.00 ^{a}	89.13 ^{a}
K	+	M	116.82	00.00	4546.09 ^{a}	00.00	4429.27 a	0000.00	84.95 ^{a}	00.00
		P	106.20	19.76	4345.62 ^{a}	1416.18 ^{a}	4239.42 a	1396.42 a	80.12 ^{a}	91.20 ^{a}
	-	M	116.82	00.00	3360.75 ^{b}	00.00	3243.93 b	0000.00	77.23 ^{a}	00.00
		P	106.20	19.76	3603.59 ^{b}	750.06 ^{c}	3496.39 b	730.3 c	80.12 ^{a}	87.55 ^{a}
B	+	M	116.82	00.00	3141.56 ^{b}	00.00	2479.74 c	0000.00	76.89 ^{b}	00.00
		P	106.20	19.76	3041.23 ^{b}	1422.37 a	2945.03 bc	1402.61 a	78.12 ^{b}	88.12 ^{a}
	–	M	116.82	00.00	2311.07 ^{c}	00.00	1400.25 d	0000.00	65.11 ^{c}	00.00
		P	106.20	19.76	1804.91 ^{c}	592.03 d	1385.71 d	572.27 d	61.32 ^{c}	76.55 ^{b}
Pooled Means										
E			111.51	19.76	4707.57 ^{l}	1221.04	4596.06 L	1201.28 L	82.25 L	89.84 ^{L}
K			111.51	19.76	3964.51 ^{m}	1083.12	3853.00 m	1063.36 ^{Lm}	79.86 L	89.38 ^{L}
B			111.51	19.76	2161.69 ^{n}	1007.20	2050.18 n	987.44 m	70.86 m	82.34 ^{L}
	+		111.51	19.76	4000.87 ^{s}	1411.62 a	3889.36 s	1391.86 s	65.33 s	89.96 ^{s}
	-		111.51	19.76	3221.64 ^{t}	795.95 b	3110.13 t	776.19 t	61.32 s	84.41 ^{s}
		M	111.51	00.00	3619.63 ^{x}	00.00	3508.12 x	0000.00	60.29 x	00.00
		P	111.51	19.76	3600.88 ^{y}	1103.79	3489.37 x	1084.03	66.19 x	87.18

10.88±1.10), (EFP 10.19±0.95), (KUP 9.74±1.34 and KFP 8.71±0.95), (BFM 8.24±1.70), and (BUP 6.31±0.50) then (BFP3.17±0.50). However, there were no significant differences between (EFM and EUM), and also between (EFP and EUP), (KFM and BUM), and (EFP and KFP), (BFM and BUM), and (KUP).

Total yield

Total yield (TY) under different treatments for Nile tilapia, regardless of fertilization and culture system decreased significantly ($P<0.05$) from 5,811 tons/feddan in (E) to 4,894 tons/feddan in (K) then to 2,668 tons/feddan in (B). As for the grey mullet there were no significant differences among location on TY. It was 1,191, 1,083 and 1,007 tons/feddan for (E), (K) and (B) respectively. For both of Nile tilapia and Grey mullet regardless of location and culture system, mean of TY increased significantly ($P<0.05$) with (F) treatments, with values of 4,939 and 1,411 tons/ feddan compared with 3,976 and 7,95 tons/feddan in (U) treatments for Nile tilapia and Grey mullet respectively. Also, TY was insignificantly affected by culture systems, and found to be 4,471 and 4,444 tons/feddan for (M) and (P) respectively.

For Nile tilapia results indicated that, TY were affected significantly ($P>0.05$) by interaction among location, fertilization, and culture system. In general (EFP, EUP) showed the greatest value of TY, while (BUM) had the lowest value. Statistical analysis didn't record any significant differences by culture systems. It was found to be 4,471 and 4,444 tons/feddan for (M) and (P), respectively.

DISCUSSION

The results of the present study revealed that there were significant differences among treatments for soil parameters (OC, TN, AN, TP and AP). The low recorded values were significantly affected by location with unfertilized ponds in B with polyculture system and the highest were recorded with fertilized ponds in E with monoculture system. These results could be attributed to elevated clay levels in soil from 12.00% in B to 26.50% in K followed by 40.00% in E. These result agrees with the results of Boyd et al. (2001), they reported that with increasing clay levels in soil the organic matter increases. Also they stated that 0–2 cm layer contained 0.92 ppm water-extractable phosphorus. This is a high concentration, which probably resulted from recent applications of phosphate fertilizer to ponds.

Boyd and Munsiri (1996) demonstrated that phosphorus fertilizers recently adsorbed by pond soil is more readily released than other forms of soil phosphorus. However, ponds in B were considered the most recent ponds in this study compared with K and E (the primal type of soil). On the same perception, Munsiri et al (1995) reported that new pond have lower concentration of soil organic matter than old ponds. Boyd et al (1997) when studied ponds that were 12 years old and three ponds that were three years old, their results showed that soil parameters increased in old than young ponds, and OC increased from 1.8± 0.24% to 2.28±0.05%, TN from 0.12±0.02 to 0.17 ±0.17, and TP from 0.01±0.01 to 0.09±0.01 for young and old ponds, respectively. Also, Seo and Boyd (2001) reported that pond bottom soils are recipients of large amounts of nitrogen, phosphorus, and organic matter. These substances tend to accumulate in bottom soils as ponds age. Correspondingly, Boyd (1995) reported that most aquaculture ponds are constructed in mineral soil of low OM content, but as pond age, organic matter accumulates.

On the other hand, Thunjai and Boyd (2001) collected samples from 35 ponds in Thailand with age range from 3 to 39 years old, which had been continuously used for tilapia production. They observed that the correlation between pond age and both total carbon and organic carbon concentration were weak and nitrogen in bottom soil did not differ with pond age.

Nonetheless, the soil parameters of the present study reported a significant decrease with polyculture system than in monoculture. These results come to an agreement with those of Schroeder (1987). He reported that organic matter accumulation rates of 0.87g m-1 d-1 for intensive polyculture ponds, while in intensive tilapia ponds the rate ranged from 100-1500 g m-1 d-1. However, Green and Boyd (1995) reported that in tilapia monoculture system the corresponding values were 18-21% and 79-82% respectively. While, Schroeder et al (1990) found that in polyculture ponds common carp, *Cyprinus carpio*, silver carp, *Hypophthalmichihys molitrix*, Nile tilapia, *Oreochromis niloticus,* and grass carp, *Ctenopharyngodon idella*, about 11-16% of the applied N was recovered in fish at harvest and the remaining N (84-89%) was released to pond environment.

Basically, the influence of aquaculture on sediment and the benthic environment is due to the deposit of organic wastes (Cornel and Whoriskey, 1993; Sunlu et al, 1999; Schendel et al, 2004; and, Alpaslan and Pulatsii, 2008).

The C/N ratio of the present study differed significantly by location and type of culture. C/N ratio decreased significantly from in E, to K followed by B. This might be attributed to the variations among soil contents in OC and TN. Also its significant decrease with polyculture system more than in monoculture system might be due to the presence of grey mullets which could effectively remove 4.2g OC, 0.70g N and 7.2mg P/kg mullet/m/day from the organically enriched sediment (Lupatsch et al 2003). On the other hand, treatments with applied fertilizers did not affect the C/N ratio. These results agree with Munsiri et al (1995) that conducted a study at Auburn University, found that there were no significant differences of C/N ratio in fertilized ponds.

The present study showed that the highest value of total yield (TY) found in fertilized pond with polyculture system at E was higher than that of B. Although, soil type affected significantly (*P<0.05*) the (TY) and (NY) as ponds at E were higher than that of K and B. These could be attributed to the variation of soils at different locations. In the same manner, Thunjai (2002) reported that, generally soils differ from location to another with respect to properties such as soil depth, distribution of particle size, type of clay, concentration of organic matter, and thickness of individual horizons within the soil profile. Also, Jana and Webster (2003) reported that water and soil conditions have a great influence on the efficiency of shrimp production.

Jiwyam (1996) studied the effect of soil on fish production (*O. niloticus*). He found that fish pond mud tanks gave the highest production. Bagghe et al. (1990) studied the relationship between fish pond soil and fish production in West Bengal and found a significant correlation between soil type and fish production with sandy loam soils giving the highest productivity.

Furthermore, Mendez et al. (2004) found that texture of sediment influence shrimp yield, with lower values for sandy sediment relative to silty sediments. They also established significant differences in final weight, survival rates, and shrimp yield among treatments.

Besides, TY and NT decreased significantly with unfertilized treatments more than with fertilized ponds. These results corresponds with that of Brunson et al (2001) whom reported that fish harvest of a fertilized pond can be triple that of on unfertilized pond. Also, McNabb et al (1990) indicated that fertilization of a fish pond increase the amount of harvestable fish.

On the other hand, TY and NY decreased significantly with monoculture system more than with polycultue. The findings herein agrees with those of Tian et al (2001) whom reported that polyculture system allowed increased production with the same amount of feed. Also, El-Sayed, (2006) reported that tilapia can produce high yields in monoculture systems because they can fill several feeding niches, compared to selective feeders such as carp.

Furthermore, Edirisinghe (1990) found that stocking of common carp, big-head carp and Nile tilapia in fertilized ponds at various densities at a ratio of 2:1 or 1:2 big-head carp: tilapia and 2:3:4 big-head carp: common carp: tilapia, for154 days significantly increased the growth rate of big-head carp and tilapia, indicating that the incorporation of a bottom feeder was beneficial.

Therefore, the present study acknowledged that fertilization was more effective in sandy soil than clay-sandy or clay soil. Consistently, despite of location and culture system, fertilized ponds were higher in final yield than unfertilized ponds. In addition, polyculture system was better than monoculture regardless to location and fertilization.

REFERENCES

Alpaslan. A. and S. Pulatsü. (2008). The Effect of Rainbow Trout (*Oncorhynchus mykiss*) Cage Culture on Sediment Quality in Kesikköprü Reservoir. Turkey. *Turk. J. of Fish. and Aqua. Sc., (8):pp. 65-70*

Avnimelech .Y and G. Ritvo. (2003). Shrimp and fish pond soils: processes and management. Aqua. (220), pp. 549-567.

Bagghi, S., A. Haque and S. Acharjee.(1990). Effect of pond soil on production of fish. Envir. and ecol. (8)3, pp. 1037-1038.

Banerjea, S.M. (1967). Water quality and soil condition of fish ponds in some states of India in relation to fish production. Indian J. Fish. 14, pp. 113-144.

Bhakta, J.N., D.Sarkar, S. Jana, and B.B. Jana, (2004). Optimizing fertilizer dose for rearing stage production of carps under polyculture. Aqua. (239), pp. 125–139

Boyd, C.E. (1976). Nitrogen fertilizer effects on production of tilapia in ponds fertilized with phosphorus and potassium. Aqua. 7: 385 - 390.

Boyd, C.E. (1990). Water Quality in ponds for Aquaculture. Alabama Agricultural Experiment Station, Auburn University, Auburn, Alabama, 482 pp. Boyd, C.E. (1995). Bottom Soil, Sediment, and Pond Aquaculture. Chapman and Hall, New York.

Boyd, C.E. (1995). Bottom Soil, Sediments and Pond Aquaculture, Chapman and Hall, New York, USA (1995) 350 pp.

Boyd, C.E. (1996). Source water, soil, and water quality impacts on sustainability in aquaculture. Proceedings of the pacon conference on sustainable aquaculture. (95), pp. 24-33.

Boyd, C.E. and S. Zimmermann. (2000). Grow-out systems-water quality and soil management. Freshwater prawn culture. PP. 221-238

Boyd, C.E., C.W. Wood, T. Thunjai, M. Rowan, and K. Dube. (2001). Pond soil characteristics and dynamics of soil organic matter and nutrients. In: A. Gupta, K. McElwee, D. Burke, J. Burright, X. Cummings, and H. Egna (Editors), Eighteenth Annual Technical Report. Pond Dynamics/Aquaculture CRSP, Oregon State University, Corvallis, Oregon, pp. 1–12.

Brunson, M.W., N. Stone and J. Hargreaves. (2001). Fertilization of Fish Ponds. Southern Regional Aquaculture Center Publication, No. 471. Bass and zooplankton dynamics in fertilized rearing ponds. Prog. Fish-Cult., 47: 213-223.

Cornel, G.E. and F.G. Whoriskey. (1993). The effects of rainbow trout (*Oncorhynchus mykiss*) cage culture on the water quality, zooplankton, benthos and sediments of Lac du Passage, Qöuebec. Aquaculture, 109: 101-

Edirisinghe, U. (1990). Suitability of common carp for inclusion in bighead carp–Nile tilapia polyculture systems in ponds fertilized with duck litter. In: Hirano, R. and Hanyu, I. (eds) *The Second Asian Fisheries Forum*. Asian FisheriesSociety, Manila, Philippines, pp. 201–204.

El-Sayed, A.-F. M. (2006). Tilapia culture. CABI Publishing, Cambridge, MA, USA. 293 pp.

Green, B.W. and C.E. Boyd. (1995). Chemical budgets for organically fertilized fish ponds in dry tropics. J. of W. Aqua. Soc., Vol. (26), pp.284-296.

Hickling, C.F. (1971). Fish Culture. Faber and Faber. London. pp.225.

Jana, B. B. and C.D. Webster, (2003). Bottom soil and water quality management in shrimp ponds- Sustainable aquaculture: global perspectives Binghamton: Food Products Press, 2003 p.11-33.

Jiwyam, W. (1996). Effect of organic matter in bottom sediment of fish pond on growth and production of Nile tilapia (Oreochromis niloticus L.). kaen Kaset= Khon Kaen Agriculture Journal. 1996. 24: 2, 90-94. 15.

Lupatsch, I., K. Timor, and D.L. Angel. (2003). Assessment of the removal efficiency of fish farm effluents by grey mullets: a nutritional approach. Aqua. res. Vol. (34).pp. 1367-1377.

McNabb, C.D., T.R. Batterson, B.J. Premo, C.F. Kund-Hansen, H.M. Eidman, C.K. Lin., J.E. Jaiyen Hansen and R. Chuenpagdee, (1990). Managing fertilizers for fish yield in tropical ponds in Asia. pp. 169-172. In: Reijiro Hairano and Isao Hanyu (eds.). The second Asian Fisheries Forum. Proceedings of the Asian Fisheries Society, Manila Philippines.

Milstein, A. (1997). Do management procedures affect the ecology of warm water polyculture ponds? *W. Aqua.*, 28 (3), 12–19.

Munsiri, P., C.E. Boyd., D.R. Teichert-Conddignton and B.F. Hajek. (1995). Texture and chemical composition of soils from shrimp ponds near Choluteca, Honduras. Aqua. Inter. Vol. (4) , pp. 157-168.

Munsiri, P., C.E. Boyd, B.W. Green, and B.F. Hajek. (1996). Chemical and physical characteristics of bottom soil profiles in ponds on haplaquents in an arid climate at Abbassa, Egypt. J. Aquacult. Tropics, 11: 319-329.

Ntengwe. W.F., and O.M. Edema. (2008). Physico-chemical and microbiological characteristics of water for fish production using small ponds. Physics and chemistry of the Earth, Parts A/B/C, Vol. (33), no. 8-13,pp. 701-707.

Schendel, K.E., Nordstrom, E.S. and Lavkulich, M.L. (2004). Floc and sediment properties and their environmental distribution from a marine fish farm. Aqua. Res., 35: 483- 493.

Schroeder, G.L. (1987). Carbon and Nitrogen budgets in manure fish ponds on Israel's coastal plain, Aqua., Vol. (62): pp. 259-377.

Schroeder, G.L., G. Wohlfarth, A. Alkon, A. Haley and H. Krueger. (1990). The dominance of algal-based food webs in fish ponds receiving chemical fertilizers plus organic manures. Aqua., vol. (86):pp. 219-229.

Sunlu, U., Ö. Egemen, A. Kaymakçý, and A. Tüzen. (1999). Investigation of netcage aquaculture effects on surficial sediment in Urla Ýskele (Ýzmir). X. Ulusal Su Ürünleri Sempozyumu. Bildiri ve Posterler (I). 22-24 , Adana.

Thunjai, T. (2002). Bottom soil quality in fish ponds of different ages in Thailand and suggestions for its management. Ph.D. Dissertation, Aubun University.

Thunjai, T. C.E. Boyd, and K. Dube. (2001). Pond soil pH measurement. J. World Aquacult. Soc., Vol. (32), (2), pp: 141-152.

Tian, X., D. Li, S. Dong, X. Yan, Z. Qi, G. Liu, and J. Lu. (2001). An experimental study on closed-polyculture of penaeid shrimp with tilapia and constricted tagelus. Aqua. Vol. (202): pp. 57–71.

Wurts, W.A. (2004). Organic fertilization in culture ponds. W. Aqua. Mag. Vol. (35): (2): 64 – 65.

Yi, Y. and Lin, C.K. (2001). Effects of biomass of caged Nile tilapia (*Oreochromis niloticus*) and aeration on the growth and yields in an integrated cage-cum-pond system. Aqua., Vol. (195):pp. 253–267.

تأثير التسميد ونظام الاستزراع على المواد العضوية وديناميكية النيتروجين والفوسفور في أنواع مختلفة من التربة في أحواض البلطي النيلي

غادة سلام ، وليد فايد ، سامي الزعيم ، علاء الدحار ومحمد سلامة

قسم الإنتاج الحيواني والسمكي ، كلية الزراعة – سابا باشا – جامعة الإسكندرية

أجريت هذه الدراسه لبيان أثر إضافة كلا من التسميد العضوى إضافة إلى الكيماوى إلى أنواع مختلفه من التربه من حيث طبيعة التربه (طينيه – طينيه رمليه – رمليه) على محتوى كل نوع من الأنواع من العناصر الغذائيه الأساسيه (الكربون العضوى –النيتروجين الكلى والمتاح – الفوسور الكلى والمتاح) كذلك تم دراسة أثر تربية أسماك العائله البوريه إلي جانب البلطى على ديناميكية حركة العناصر الغذائيه لكل نوع من أنواع التربه السابقه وأثر ذلك على إنتاجية أحواض تربية أسماك البطلى النيلى فى جمهوريه مصر العربيه.

تمت دراسة ثلاث أنواع مختلفه من التربه (طينيه وطينيه رمليه ورمليه) فى ثلاث أماكن منفصله متباعده عن بعضها البعض (إدكو و كفر الدوار وبرج العرب) على التوالى. تم تربية البلطى بمتوسط وزن إبتدائى ٥,٣١ جم وبكثافة ٢٢ ألف إصبعيه للفدان فى النظام الموحد و٢٠ إصبعيه للفدان فى النظام المتعدد إضافة إلى البورى بمتوسط وزن إبتدائى ٩,٨٨ جم بكثافه ٢٠٠٠ إصبعيه للفدان. وتم تغذية الأسماك على عليقه تجايه مصنعه تحتوى على ٢٥% بروتين لمدة ٢٤٠ يوم. كما إستخدم السماد العضوى بالنسبه للأحواض المسمده بمعدل ٥٠٠كجم/فدان/ أسبوع إضافه إلى ١٤ كجم/فدان/ أسبوع من السماد الكيماوى بنسبة ١:٤ نيتروجين: فوسفور. وقد أظهرت النتائج- سجلت نتائج تحليل التربة اعلى نسبة طمى واقل نسبة رمل فى ادكو(٤٠% و٣٦%) تليها كفر الدوار(٢٦،٥%و ٥٣،٥%) ثم برج العرب حيث سجلت أقل نسبة طمى وأعلى نسبة رمل(١٢،٥%و٧٠,٦٩%). كذلك سجلت نتائج التحليل أعلى نسبة للكربون العضوى والنيتروجين الكلى والمتاح والفوسفور الكلى والمتاح فى إدكو تلتها كفر الدوار ،ثم سجلت برج العرب اقل نسبه.

- كما اظهرت النتائج إرتفاع معنوى فى قيمة كل من الكربون العضوى والنيتروجين الكلى والمتاح والفوسفور لكلى والمتاح فى التربة فى حالة تسميد أحواض الإستزراع. وعلى النقيض إنخفضت قيم هذة القياسات مع نظام الاستزراع المتعدد.

- كان الوزن النهائى والانتاج الكلى) فى صالح التربه الطينيه (إدكو) حيث سجلت أعلى قيمه لإنتاجية الفدان وكذلك ارتفع الإنتاج الكلى للاسماك بإستخدام التسميد فى جميع المناطق خاصة برج العرب وأيضا باستخدام نظام الاستزراع المتعدد (تربة البورى إلى جانب البلطى).

- لم تختلف حيوية الاسماك معنويا بين إدكو وكفر الدوار ولكنها إنخفضت بمعنوية فى برج العرب حيث إنخفضت حيوية أسماك البلطى من ٨٣% فى إدكو وكفر الدوار إلى ٦٢% فى برج العرب وعلى العكس لم تتأثر حيوية البورى فى الأحواض المسمدة ولكنها كانت أقل بمعنوية فى الغير مسمدة. لذا يوصى بإستخدام التسميد ونظام الإستزراع المتعدد خاصه فى الأراضى الفقيره فى العناصر الغذائيه فهذا يرفع من إنتاجيه الفدان لأكثر من الضعف ويؤدى إلى ربحيه جيده للمزرعه.