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YIELD AND PERFORMANCE OF TWO SPECIES OF TILAPIA UNDER DIFFERENT POND ENVIRONMENTS

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Abstract

The effect of two different nutrient input systems on Nile tilapia alone (*Oreochromis niloticus*), Blue tilapia (*O.aureus*) alone, as well as mixed of two species production was studied in eighteen earthen ponds. In the first system, chemical fertilizer (CF) 22.8 kg/feddan and 38.76 kg/feddan were applied weekly. In the second system, organic fertilizer at a rate of 420 kg/feddan/week, poultry manure for two months followed by artificial feeding 90 days using a diet containing 25% crude protein fed at a rate of 3% of fish biomass daily (OF) were applied in ponds. In each system sex reversed Nile tilapia alone (N) and blue tilapia alone (B), as well as, a mixed culture from both species (M) at a rate of 1:1 were tested in three replicates each. Fish were stocked at a stocking rate of 8000 fish/feddan with an average weight 0.5gm on 1st July 1994. Duration of grow-out period averaged 158 days. Mean average final weight of Nile tilapia was significantly higher (106g) than blue tilapia (94g) and mixed culture of both species (95g) in chemical fertilization system and average yield was 582, 709 and 658 kg/feddan, respectively. In (OF) system, Nile tilapia had higher final weight (235g) and yield (1490 kg/feddan) than blue tilapia ((182g) and the mixed culture of both species (181g). Average final fish weight and yield within the same system differences were insignificant between (B) and (M). Physical, chemical and biological conditions were affected by fertilization system compared with fish species.

INTRODUCTION

In Egypt, both Nile tilapia (*O.niloticus*) and blue tilapia (*O.aureus*) are good cultured species and endemic. As a result of severe cold weather in the Egyptian Delta periodically as happened during the 1991/1992 winter months (December through February), most Nile tilapia broodstock in many fish farms died. *O.aureus* are much more tolerant to low temperatures, survive winters in Egypt without having to be over-wintered indoors. The increased cold tolerance of *O.aureus* would give this species a competitive advantage over *O.niloticus* for pond culture in the Egyptian Delta.

The objective of this experiment was to compare production performance and production of *O.niloticus* and *O.aureus* reared in ponds managed under two different nutrient input systems.

MATERIALS AND METHODS

This study was carried out in eighteen earthen ponds (each of a total area 0.25 feddan) located at Central Laboratory for Aquaculture Research in a complete randomized design using the 2x3 factorial arrangement. Two systems of fertilization management were tested. In the first system, chemical fertilization (CF) using urea and monosuperphosphate was applied at a rate of 22.8 kg/feddan, and 38.75 kg/feddan weekly during the whole experimental period which lasted 158 days after start. In this system, Nile tilapia alone (N) and blue tilapia alone (B), as, well as a mixed culture from both species (M) at a rate of 1:1 were tested in three replicates for each. In the second system, organic fertilization at a rate of 420 kg/feddan/ week, poultry manure for two months followed by artificial feed 90 days using a diet containing 25% crude protein fed at a rate of 3% of the total fish biomass daily were applied on ponds having (N) alone and (B) alone, as well as a mixed culture of both species (M). Ponds were stocked with sex reversed tilapia with an average weight 0.5 g on 1st July 1994 at a stocking rate of 8000 fish/feddan. Fish were harvested on 4th December 1994.

Physical, chemical and biological characteristics of water quality were monitored biweekly between 00.70-00.80 a.m., and determined according to (APHA 1985). Gross and net primary productivity and community respiration were measured monthly using the free water diurnal oxygen method (Hall and Moll 1975). Analysis of variance (one way ANOVA) and Duncan's multiple range test were used to determine difference in treatment means (Snedecor and Cochran 1978). Fish were sorted to size classes according to Egyptian market: 1st class (1-5 fish/kg), 2nd class (6-12 fish/kg), 3rd class (13-25 fish/kg) and 4th class (26-40 fish/kg)

RESULTS AND DISCUSSION

Physical, chemical and biological conditions of pond water are illustrated in Table 1. Average dissolved oxygen (DO) in pond water for CFN, CFB, CFM, OFN, OFB and OFM were 6.71, 6.32, 6.17, 4.71, 4.56 and 4.13 mg/l, respectively. Average DO in pond water fertilized with CF was significantly greater than that applied with

Table 1. limunological characteristics of water in experimental ponds.

Characteristic	Treatment					
	CFN	CFB	CFM	OFN	CFB	CFM
Water temperature ^{o}C	24.0a	24.5a	24.6a	25.2a	24.7a	25.7a
Dissolved oxygen (mg/l)	6.71a	6.32a	6.17a	4.71b	4.56b	4.13b
pH	9.5a	9.42a	8.98a	8.6b	8.3b	8.4b
Total phosphorus (mg/l)	1.81a	1.79a	1.85a	2.36b	2.15b	2.23b
Orthophosphate (mg/l)	0.61b	0.68b	0.63b	0.79b	0.73b	0.8b
Nitrate (mg/l)	0.65a	0.63a	0.71a	0.11a	0.17a	0.21a
Chlorophyll-a (mg/l)	182.7b	185.1b	193.2b	219.39b	202.1b	210.2b
phytoplankton abundance (organisms/l)	7138b	6937b	6853b	9136a	8753a	9073a
Zooplankton abundance (organisms/l)	269a	249a	271a	93a	79a	89a
Net primary productivity (g Cm3/day)	10.57a	9.89a	9.93a	11.32b	10.32b	10.91b
Gross primary productivity (g Cm3/day)	15.21a	14.65a	14.65a	17.32b	16.32b	16.27b
Community respiration (g Cm3/day)	14.82a	13.56a	13.92a	16.29b	15.62b	15.98b

Means followed by the same letter-in row are not significantly different (P<0.05).

Table 2. Growth and yield performance data.

Groups	Average final weight (g)	Daily gain (g)	Fish yield (kg/feddan)	Yield increment (kg/feddan/day)	Survival (%)
CFN	106 c	0.67c	582 c	3.68 d	68.63 d
CFB	94 d	0.59 c	709 c	4.48 d	94.30 a
CFM	95 d	0.60 c	658 c	4.16 d	87.80 b
OFN	235 a	1.48 a	1490 a	9.43 a	79.25 c
OFB	182 b	1.15 b	1051 b	6.65 c	86.40 b
OFM	181 b	1.14 b	1224 b	7.74 b	87.57 b

Means followed by the same letter in row are not significant (P<0.05).

OF system. As a result of mineralization and decay of organic matter in the poultry manured ponds, the dissolved oxygen was reduced in the OF system. Overall pH value of pond water was significantly higher (9.3) for pond water in CF than that in OF system (8.43). In pond water, manure decomposition provided algae with inorganic carbon through decomposition and release of CO2. This increased algae productivity in fish ponds (McNabb *et al.* 1990). Chicken litter is alkaline, and because CO2 is released during the decomposition, it probably increased the solubility of CaCO3 (Teichert-Coddington *et al.* 1992) .

Pond water fertilized with CF had significantly higher chlorophyll-a content mg/l than OF system (187 and 210.56 mg/l, respectively). Chlorphyll-a in water of manured ponds was 12.5% higher than in ponds fertilized with CF. In the organic fertilization ponds, results showed that fish obtained organic carbon from primary productivity and manure-derived detritus. Ponds fertilized with poultry manure supported higher zooplankton density.

Zooplankton density was higher ($P<0.05$) in ponds fertilized with organic fertilization (263 organisms /l) than in ponds treated with chemical fertilizer (87 organisms/l). Release of soluble nitrogen and phosphorus stimulated algae production which in turn can be consumed by fish directly or after processing by zooplankton and microbes (Colman and Edwards 1987). Water quality conditions were not affected by fish species within the same system.

The results of fish performance are presented in Table 2. Average of final weight of fish at the end of the experimental period for groups CFN, CFB, CFM, OFN, OFB, and OFM were 106, 94, 95, 235, 182 and 181g, respectively.

The statsitical evaluation of results revealed that, differences in final weight among treatment groups were significant ($P<0.05$).

Net fish yield was higher in group OFN (1490 kg/feddan) than other groups. Net fish yield increment at harvest ranged from 3.68-9.43 kg/feddan/day. The most productive group of the experiment was in Nile tilapia in ponds treated with OF system (9.43 kg/feddan/day). Growth rate of fish was the lowest in group CFB (0.59 g/fish/day), followed by CFM group (0.6 g/fish/day) indicating that natural food organisms were insufficient to support high growth. Survival rate was insignificant between the two systems regardless of fish species .

Regardless of system of fertilization as presented in Table 3, average of final weight of Nile tilapia (N), blue tilapia (B) and a mixed of both species (M) at the end of experimental period was 170, 138 and 138g, respectively.

Regardless of species cultured, as illustrated in Table 4, averages of total fish production per feddan as affected with fertilization system for CF and OF systems were found to be 647 and 1257 kg fish per feddan, respectively. The analysis of variance for fertilization system indicated that, difference among systems applied were found to be significant ($P<0.05$) for the favour of organic fertilization, followed by artificial feeding as compared with the chemical fertilization throughout the experimental period. Yield in class size affected by fertilization system showed that the bulk of the fish harvest in CF system was raised under 3rd class (73.72%), while, the bulk of harvest from the OF system (49.9%) fell under 1st and 2nd classes.

The percentage of charge in Table 4 showed that the final average fish weight in OF system was 202.7% more than in CF system. Fish yield in OF system was greater 194.3% than that in CF system. First class fish yield was higher 31400% as compared with those in OF system.

The results of this study indicated that, organic fertilization for two months poultry manure at a rate of 420 kg/feddan for two months followed by artificial feed containing 25% crude protein fed at a rate of 3% of the total fish biomass daily applied on ponds having sex reversed Nile tilapia stocked at a rate of 8000 fish/feddan gave good growth (235g final weight/fish), high survival rates (79.25%) and higher fish yield (1490 kg/feddan) after 158 days. Water quality was in a good condition. The results may help aquaculture system to increase average final weight and fish production.

Table 3. Effect of species regardless of system of fertilization on productive performance of N and B tilapia.

Species	average final weight (g)	Daily gain (g/day)	Fish yield (kg/feddan)	Yield increment (kg/feddan/day)	Survival (%)	Fish yield in size class (kg/feddan) I	II	II	IV
N	170 a	1.07 a	10.6 a	6.55a	73.94 c	601a	269 a	21a	145 a
B	138 b	0.87 b	880 b	5.56b	90.35 a	18c	818 a	26a	18c
M	138 b	0.87 b	941 b	5.95 b	87.68 b	312 b	526 b	34a	69 b

Means followed by the same letter are not significantly different (P<0.05).

Table 4. Effect of fertilization system regardless of species.

System	average final weight (g)	Daily gain (g/day)	Fish yield (kg/feddan)	Yield increment (kg/feddan/day)	Survival (%)	Fish yield in size class (kg/feddan) I	II	II	IV
CF	98.33b	0.662b	647b	4.09b	83.57	2b	14b	477a	157a
OF	199.33a	1.26a	1257a	7.95a	84.41a	628a	439a	8b	182a
% of charge	202.7	202.57	194.28	194.37	101	31400	3133	1.68	116

Means followed by the same letter are not significantly different (P<0.05).

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إنتاجية أسماك البلطى النيلى والبلطى الأزرق تحت بيئتين مختلفتين

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تأثير التغذية على اسماك البلطى النيلى والبلطى الازرق وخليط منهما بنسبة ١:١ فى عدد ١٦ حوض ترابى مساحة الحوض ٠,٢٥ فدان.

المعاملة الأولى: التسميد المعدنى ٢٢,٨كجم فدان يوريا، ٣٨,٧٦كجم / فدان سوبرفوسفات أسبوعيا.

المعاملة الثانية: التسميد العضوى ثم التغذية الصناعية بأضافة زرق الدواجن بمعدل ٤٢٠ كجم /فدان اسبوعيا لعدد ٨ دفعات ثم بالتغذية الصناعية ٢٥٪ بروتين بمعدل ٣٪ من وزن الاسماك وحتى نهاية التجربة.

تم تخزين الاحواض بتاريخ ١ يوليو ١٩٩٤ بمعدل ٨٠٠٠ سمكة/فدان بمتوسط وزن السمكة ٠,٥ جرام.

كانت الانتاجية السمكية ٦٤٧ و ١٢٥٧ كجم/فدان فى معاملة التسميد المعدنى والتسميد العضوى ثم التغذية على التوالى.

متوسط وزن الاسماك النهائى لاسماك البلطى النيلى (١٠٦ جم) وهى اعلى معنويا عن النيلى الازرق (٩٤ جم) وايضا التخليط منهما (٩٥ جم).

وفى التسميد المعدنى كان متوسط الانتاجية ٥٨٢ ، ٧٠٩ ، ٦٥٨ كجم /فدان وذلك لاسماك البلطى النيلى - الازرق - والخليط منهما .

لم تظهر أية فروق معنوية بين البلطى الازرق والخليط أو بين نوعى الاسماك فى متوسط وزن السمك النهائى والانتاجية داخل المعاملة السمادية الواحدة .

الظروف الفيزيائية و الكيمائية والبيولوجية تأثرت بنوع السماد ولم يؤثر عليها نوع السمك.