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Polyculture of *Machrobracium nipponense* (De Haan, 1849) with *Ctenopharyngodon idella* Val., 1844 in laboratory conditions

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Abstract - The laboratory test on effect of grass carp (*Ctenopharyngodon idella*) at different densities in polyculture with oriental river prawn (*Macrobrachium nipponense*) was the aim of this study. The experiment includes three treatments, prawn and 6 grass carp m^{-2} (T1), prawn and 8 grass carp m^{-2} (T2) and prawn and 10 garss carp m^{-2} (T3), with three replicates in each. The prawn stocking density was the same in all treatments (10 juvenile m^{-2}). Feeds were applied twice daily for prawn. Feeding rates were gradually reduced to 10 - 7% of body weight from the beginning to the last month. Water quality parameters (temperature, pH, salinity and DO) did not vary significantly ($P>0.05$).The mean of juvenile weight in the final weights and the increasing weight and daily growth were differed significantly ($P<0.05$) between the treatment T1 as well as of the two treatments T2 and T3, Which had not significant differences ($P>0.05$). While not significant differences ($P>0.05$) in both survival and relative growth rates in all transactions. It was found that the addition of different grass carp did not affect on rates of both survival and relative growth of prawns, evidence favorable to store fish with prawn. It can be concluded that the treatments T3 was the best for prawn-fish polyculture.

Keywords: Polyculture, *Machrobracium nipponense*, Oriental river prawn and Grass carp.

Introduction

The polyculture of *Macrobrachium* sp. with non-carnivorous Chinese and Indian carps and tilapia, observed a shift in feeding habits of both silver and grass carp to detritus and benthic organisms under effect of severe competition in densely stocked polyculture ponds (Ling, 1962; Schroeder, 1980).Most studies of *Macrobrachium* polyculture with non-carnivorous fish have involved low prawn stocking densities and conventionally high feeding rates (Brick and Stickney, 1979). Polyculture of giant freshwater prawn along with Indian major carps is becoming popular compared to monoculture among fish farmers due to the high cost of management, low survival and differential growth of prawn under monoculture esystems (Vasudevappa *et al.*, 1999).

The presence of fish in a polyculture system serves as a biological control over development of zooplankton, phytoplankton and filamentous algae, which result in ecological instability of the pond ecosytem (Baissac, 1976). Indian major carps and common carp when grown with prawn gave a productions level of 1388-1695 kg in 5-8 months in Orissa (Ahemed, 1995). However, much higher fish production (4982-8217 kg/ha) has been observed by D' Abramo *et al.* (1986) when catfish and prawn were cultured together, though the prawn production remained low (125-172 kg/ha).

There are several studies on mixed farming between shrimp and fishes (Akiyama and Anggawati, 1999; Fitzsimmons, 2001; Haque *et al.*, 2003; Pervin *et al.*, 2012; Laxmappa and Krishna, 2015). The aim of the current study was to know or show the effect of different densities of fishes on prawn growth, and take advantage of it during future applications in aquaculture ponds for the development of culture and reality, and to encourage farmers to grow prawn for increase their income.

Materials and Methods

The experiments was conducted during the a period of 45 days extended between April to June 2015 at the aquaculture Laboratory, Marine science center, Basra University, Iraq; 9 rectangular ponds (all ponds of 1 m^{-2} each) with an average depth of 0.30 m were used. The trial was conducted in a completely randomized design into three different treatments with three replications each. Stocking densities of oriental river prawn (*Machrobracium nipponense*) were the same in all treatments but different in case of grass carp (*Ctenopharyngodon idella*) as shown in the Table (1).

Table 1. Experimental design.

Species	Density		
	T1	T2	T3
Prawn (*M.nipponense*)	10	10	10
Grass carp (*C.idella*)	6	8	10

T= treatment.

The juvenile of oriental river prawn (*M. nipponense*) collected from the Shatt al-Karma in Basra city. While carp fingerlings brought from fish hatchery in Marine Sciences Center. The basins were sterilized before starting experiments with the solution of $CaCO_3$ commercial for one hour. It left at the ponds for several days before starting experiments for the purpose of acclimatization. Feeds were based on laboratory-made pellet (fish meal, soybean cake, wheat flour, maize flour, vitamins and minerals) and Fed twice (8 am and 2 pm). Formulated feeds were applied at 10% body weight up to 30 days and reduced to 7% up to the end of the experiment. Water temperature (°C), pH range, Salinity (psu) and dissolved oxygen DO (mg l^{-1}) were measured every week at morning (10 am). The weight of prawn specimens were measured as carps weight by a digital electric balance every 15 days using small hand net to observe the growth of prawn and carps. Growth parameters; weight gain (mg), daily growth rate GR (mg/day), relative growth rate RGR (%) were calculated according to Jobling (1993), while survival rates (%) by Tang *et al.* (1985). And conducted daily sustainability basin tests of cleaning filters and the partial switch to water. For the statistical analysis of the data, one-way ANOVA (Analyzed of Variance) was done by using the SPSS (Statistical Pakage Social Science) version-16 was used, LSD Significance was assigned at the 0.05 level.

Results

Water Quality Parameters:

The mean values of water quality parameters from different treatments were shown in Table (2). There were no significant differences ($P>0.05$) between the measurable environmental factors among all basins experiences through various treatments.

The mean values of water temperature were more or less close to the 26 °C in all treatments. pH was considered as an important factor in freshwater prawn culture. The mean values of pH range were 7.57 ± 0.40, 7.73 ± 0.25 and 7.77 ± 0.25 intreatments T1, T2 and T3, respectively. This study recommended suitable salinity range was less 2 psu. Also, this study showed the range of dissolved oxygen was found to be 6.53 ± 0.5, 6.47 ± 0.21 and 6.32 ± 0.30 (mg l^{-1}) in treatments T1, T2 and T3, respectively.

Table 2. Mean values of water quality parameters (mean ± SD) recorded from different treatments.

Parameters	Treatments			Level of significance
	T1	T2	T3	
Temperature (°C)	26 ± 3	26 ± 2	26 ± 2	NS
pH	7.57 ± 0.40	7.73 ± 0.25	7.77 ± 0.25	NS
Salinity (psu)	1.47 ± 0.15	1.50 ± 0.18	1.54 ± 0.15	NS
DO (mg l^{-1})	6.53 ± 0.5	6.47 ± 0.21	6.32 ± 0.30	NS

Growth Performances:

From the Table (3), that oriental river prawn weights primary rates and survival rates relative growth rates (RGR) if there including not significant differences ($P>0.05$), while I found significant differences ($P<0.05$) between the final growth rates and increase the weight and rates of daily growth. There was no significant difference ($P>0.05$) between the two treatments in T2 and T3, which differ significantly ($P<0.05$) with treatment T1. In fish did not notice any significant differences between all the rates. Figures (1) and (2) showed the rates of weight gain and relative growth rates between the oriental river prawn and grass carp treatments.

Table 3. Growth performance (mean ± SD) of oriental river prawn and grass carp in three treatments.

Species	Treatments			Level of significance
	T1	T2	T3	
M. nipponense				
Initial weight (mg)	245 ± 13	250 ± 14	256 ± 19	NS
Final weight (mg)	755 ± 13 ^{a}	830 ± 20^{b}	864 ± 25^{b}	*
Mean weight gain (mg)	510 ± 9 ^{a}	579 ± 27^{b}	609 ± 28^{b}	*
Survival Rate (%)	87 ± 12	87 ± 6	90 ± 10	NS
GR (mg^{-day})	11^{a}	13 ± 1^{b}	13 ± 1^{b}	*
RGR (%)	209 ± 13	232 ± 22	239 ± 24	NS
C. idella				
Initial weight (mg)	2474 ± 569	2521 ± 706	2540 ± 460	NS
Final weight (mg)	4022 ± 758	4368± 1400	4610 ± 1305	NS
Mean weight gain (mg)	1548 ± 190	1513 ± 220	2070 ± 848	NS
Survival Rate (%)	94 ± 10	92 ± 7	93 ± 6	NS
GR (mg^{-day})	18 ± 2	34 ± 5	46 ± 19	NS
RGR (%)	64 ± 8	62 ± 10	79 ± 18	NS

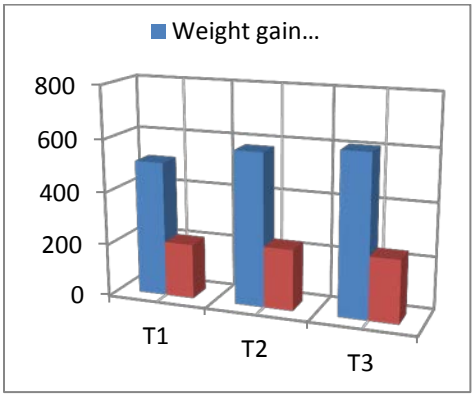

Figure 1. Weight gain (mg) and RGR (%) of prawn among three treatment.

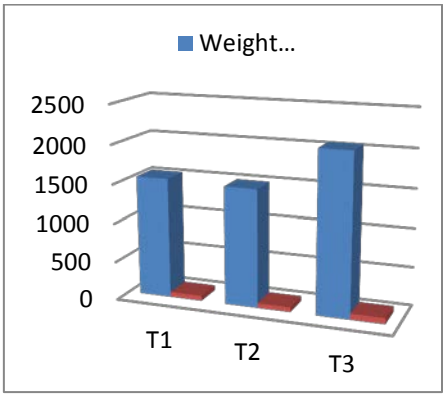

Figure 2. Weight gain (mg) and RGR (%) of grass carp among three treatment.

Discussion

Water Quality Parameters:

The environmental conditions within the optimum limits for prawn farming (Table 2). The recommended suitable temperature range for prawn-mola polyculture was more or less close to 27 °C (Pervin *et al.*, 2012). Similar to what referred by Pervin *et al.* (2012) pH were 7.63 ± 0.24, 7.58 ± 0.24 and 7.60 ± 0.21 in treatments T1, T2 and T3, respectively. These values were correspond to what was indicated by Hossain *et al.* (2000) who mentioned that the pH range of 6.8 to 8.4 was suitable for *Macrobrachium rosenbergii* culture. Aquaculture of prawn in freshwater with salinity were less 5 psu. Prawn-mola polyculture was dissolved oxygen found; 6.38 ± 1.04, 6.17 ± 1.35 and 6.14 ± 1.04 (mg l^{-1}) in treatments T1, T2 and T3, respectively (Pervin *et al.*, 2012).

Growth Performances:

The experiment of constant density of prawn and different densities of grass carp used by the study was similar to that of Pervin *et al.* (2012) who used fixed density of prawn (3 m^{-2}) and has been a change in the density(1 and 1.5 and 2 m^{-2}) of the Fish, while Haque *et al.* (2003) used different densities of prawn(15, 20, 25, 30, 35 and 40 m^{-2}) with stable densities (15 m^{-2}) for each of the three types of fish in six treatments. The progress of freshwater prawn farming in Orissa has indicated a stocking density of 10,000 - 200,000 prawn seed along with 5000 fish per hectare for getting good production of both fish and prawn (Ahemad, 1998). The weight rates of oriental river prawn with grass carp (Table 3) was recommended and can be improved values if it has aquaculture in the ponds ground which was more suitable for breeding, the breeding in ponds resulted by this study was given an impression for suitability of mixed farming prawn with fish applications field (Figures 1 & 2) the most positive results. By observing the increased weight gain rates of prawn will an increased intensity of farmed fish, as well as showing the increasing of waste orient river prawn and grass carp, while this prawn living benthic-palagic and feeding of omnivorous so it's natural to be benefited more with the increase in waste Fish. Water quality is than usual defined as the suitability of water for the survival and growth of aquaculture of prawn and fish. The present study stays higher than the 87% rate ratios during the mixed culture (Table 3). The recorded mean of survival

rates of 89.40 and 93.30% for catfish and prawn, respectively during four months growing period (D'Abramo *et al.*, 1986), but the survival rates recorded for fish and prawn were 75 and 58%, respectively (Ahmed and Varghese, 1992).

Conclusion

Growth and weight gain performance showed that the highest of oriental river prawn was recorded in T3. The combined weight gain of orient river prawn and grass carp was also highest in the same treatment. It might be concluded that there were no effects of addition of grass carp on prawn production, and T3 is the best proposition for oriental river prawn-grass carp polyculture, in which prawn can be cach crop and grass carp can be consumed at household levels.

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الإستزراع المختلط للروبيان (*Machrobracium nipponense* De Haan, 1849) مع أسماك *Ctenopharyngodon idella* Val., 1844 في ظروف المختبر

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المستخلص - أجريت الدراسة لمعرفة تأثير تربية أسماك الكارب العشبي *Ctenopharyngodon idella* وبكثافات مختلفة في الإستزراع المختلط على نمو الروبيان الشرقي *Macrobrachium nipponense*. شملت التجربة ثلاثة معاملات: المعاملة الأولى (روبيان و 6 كارب)/م^2، والمعاملة الثانية (روبيان و 8 كارب)/م^2، والمعاملة الثالثة (روبيان و 10 كارب)/م^2، ولثلاثة مكررات في كل منها. كانت كثافة إستزراع الروبيان هي نفسها في جميع المعاملات (10 يافعات/م^2) أجريت التغذية مرتين يوميا. خفضت معدلات التغذية تدريجيا من 10 إلى7٪ من وزن الجسم من البداية وحتى آخر الشهر. لم تكن هناك إختلافات معنوية ($P>0.05$) في نوعية المياه (درجة الحرارة، درجة الحموضة، الملوحة والأوكسجين المذاب). كانت هناك إختلافات معنوية ($P<0.05$) بين معدلات أوزان يافعات الروبيان للمعاملة الأولى لكل من الأوزان النهائية والزيادة الوزنية والنمو اليومي وبين المعاملتين الثانية والثالثة اللتين لم تكن بينهما فروقا معنوية ($P>0.05$)، في حين لا توجد فروقات معنوية ($P>0.05$) في كل من معدلات البقاء والنمو النسبي في جميع المعاملات. وقد تبين أن الكثافات المختلفة لأسماك الكارب العشبي لم يؤثرعلى معدلات البقاء والنمو النسبي للروبيان، وإن كثافات الإستزراع بين الروبيان الشرقي واسماك الكارب العشبي كانت ملائمة في جميع المعاملات، وإن المعاملة الثالثة كانت هي الأفضل للإستزراع المختلط.