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Comparison of Growth and Production Performance between Male and Female Giant Freshwater Prawn in Combination with Mola

K. Fatema, M. A. Wahab, R. Pervin, M. S. R. Khan and H. C. Roy
Department of Fisheries Management, Bangladesh Agricultural University, Mymensingh-2202

Abstract: An experiment was conducted to compare growth and production performance between all-male and all-female giant freshwater prawn (*Macrobrachium rosenbergii*) in combination with mola (*Amblypharyngodon mola*) at the Fisheries Field Laboratory, Bangladesh Agricultural University, Mymensingh, Bangladesh. The research was carried out for a period of 120 days in nine earthen ponds with an average depth of 1.2 m. The experiment had three treatments, viz. polyculture of all-male prawn with mola (stocking density 20,000 ha^{-1}), monoculture of all-male prawn and monoculture of all-female prawn were treated as T_1, T_2, and T_3, respectively with three replications of each and prawn stocking density was 30,000 ha^{-1} in all the treatments. Formulated sinking feeds were applied twice daily for prawn, and assuming 80% survival feeding rates were gradually reduced to 10-5% of body weight from the beginning to the last month. All water quality parameters (except transparency, chlorophyll-*a* and plankton) did not vary statistically significantly (*P>0.05*) among the treatments. Survival of prawn in respective of gender was lower in monoculture than in polyculture with mola, but did not vary significantly (*P>0.05*). Considering growth and production performance in all treatments, the male prawn showed better growth and production performance than female prawn and the highest gross and net production was recorded in treatment T_1, therefore, polyculture of all-male prawn with mola is better than monoculture.

Key words: All-male prawn, All-female prawn, Mola, Nutrient-dense, Polyculture

Introduction

Freshwater prawn has been appeared as a major aquaculture species in many countries including China, India, Indonesia, Vietnam, Bangladesh and Equador after its domestication in 1960s. Eventually, Bangladesh has entered into the commercial prawn farming in early 1990s and has become a world player as one of the seven major export countries (Wahab, 2009). Size composition of prawn at harvest is an important consideration for the profitability of its culture, since prawn prices are size dependent (Karplus *et al*., 1986). There is also a difference in growth between male and female prawn. A survey showed that annual yields from extensive ponds are in the range of 300-600 kg ha^{-1} (Asaduzzaman *et al.*, 2006), which is low compared to neighboring countries. Fisheries sector provides 58% animal protein and contributes about 2.7% in the country's economy but a large proportion of the population in Bangladesh suffers from malnutrition and about 30,000 children become night blind each year from vitamin A deficiency. Small indigenous fish species-mola (*Amblypharyngodon mola*) contain more available vitamin-A than any other freshwater fish (Thilsted *et al*., 1997). On the other hand, monoculture of prawn often can not utilize the food organisms (plankton) from the water column. So, other compatible fish species such as small indigenous species can be cultured with prawn. Therefore, the potential of addition of mola with prawn in polyculture needs investigation.

Materials and Methods

The experiment was carried out for a period of 120 days from August to December 2010 in the ponds of the Fisheries Field Laboratory, Bangladesh Agricultural University (BAU), Mymensingh. Nine rectangular earthen ponds were used (six ponds of 100 m^2 each and three ponds of 140 m^2 each) with an average depth of 1.2 m.

Pond preparation

All undesirable fishes were completely eradicated by applying rotenone at the rate of 7.5 kg ha^{-1}. Lime ($CaCO_3$) was applied at the rate of 250 kg ha^{-1} after one week of rotenone application. Urea, TSP (triple super phosphate) and cow dung were applied at the rates of 25 kg ha^{-1}, 25 kg ha^{-1} and 750 kg ha^{-1} respectively to promote plankton and algal growth. Three palm leaves were placed on the pond bottom to create shelter for prawn. The surroundings of all ponds were fenced by 1 m height nylon net to prevent the entry of predators or escaping of young prawn.

Stocking

The prawn juveniles were purchased from a nearby commercial hatchery then brought to the experimental site equipped with aerators. Mola seeds were collected from local vendor. The segregation of male juvenile of *M. rosenbergii* was done manually on the basis of following criteria: (1) male genital organ situated at the base of fifth or last pair of walking legs whereas female genital opening situated at the base of third pair of walking legs (periopods), (2) second pair of pleopod of male contains appendix masculina which is absent in female, (3) the walking legs of males are set in nearly parallel lines, with little open space between them but in case of female wider gap exist in fifth pair of walking legs, (4) ventral side of the first abdominal somite in male has a central lump

or point which can be felt with the finger whereas in case of female no such lump or point exist. The juveniles of freshwater prawn (1.75 g) and mola (0.80 g) fry were stocked according to the experimental design.

Experimental design

The experiment was conducted in a completely randomized design into three different treatments (Table 1) with three replications each viz. treatment-1 (T_1) was carried out with polyculture of all-male prawn with mola, treatment-2 (T_2) was carried out with monoculture of all-male prawn and treatment-3 (T_3) was carried out with monoculture of all-female prawn.

Table 1. Experimental design

Species	Stocking density (ha^{-1})		
	Treatment-1 (T_1)	Treatment-2 (T_2)	Treatment-2 (T_3)
Male prawn	30,000	30,000	-
Female prawn	-	-	30,000
Mola	20,000	-	-

Pond Management

Formulated feeds were applied at 10% body weight at 1st month (upto 30 days) and reduced to 7% at 2nd month and were reduced to 5% up to the end of the experiment. Feeds were prepared by using local pellet machine with following ingredients: Fish meal 15%, Mustard oil cake 20%, Soybean meal 20%, Rice bran 20%, Maize flour 20%, Molasses 4%, Vitamin-mineral premix 1%. The water level of ponds was managed by adding underground water from a deep tubewell to replace the losses due to evaporation. Prawn and mola were sampled at fortnightly intervals by using a seine net and length and weight of each species were also measured separately to assess the health condition and growth performance. Throughout the experimental period, the water quality parameters were recorded fortnightly.

Study of plankton population

Plankton samples were collected monthly by pooling 10 liter of water column from five locations in each pond and passing it through 45 µm mesh plankton net. The samples from 09 ponds were collected carefully in 09 labled plastic bottles and preserved in 10% formalin solution for further analysis. Plankton were identified by using a Sedgewick-Rafter (S-R) cell and a binocular microscope (Swift, M-4000) with phase contrast facilities. Plankton abundance was calculated using the following formula (Azim *et al*., 2001):

$$N = (P \times C \times 100) / L$$

Where, N = the number of plankton cells or units per liter of original water, P= the number of plankton counted in 10 fields, C= the volume of final concentrate of the sample (ml) and L= the volume (l) of the pond water sample.

Study of benthos

The benthic macro-invertebrate samples were collected monthly with an Ekman dredge (covering an area of lower mouth 225 cm^2). Collected organisms were preserved in 10% formalin for laboratory analysis. The abundance of macroscopic organism was expressed as density (indiv. m^{-2}) by following the formula of Welch (1984):

$$N = \frac{O}{A \times S} \times 10000$$

Where, N= Number of macroscopic organisms of profundal bottom (m^{-2}), O= Number of organisms actually counted, A= Transverse area of Ekman dredge in (cm^2) and S= Number samples taken at one sampling station

Harvesting

At the end of the experiment adult freshwater prawn and mola were harvested by netting repeatedly with a fine meshed seine net from each pond. All prawn harvested from each pond were counted, measured and weighed to evaluate the growth and production performance of manually segregated all-male giant freshwater prawn with all-female in pond culture systems. On the other hand, all harvested mola were also counted, measured and weighed.

Statistical analysis

For the statistical analysis of collected data, one-way analysis of variance (ANOVA) and Tukey's Test was performed using the SPSS (Statistical Package for Social Science, version-11.5). Significance was assigned at the 0.05% level.

Results and Discussion

Physico-chemical parameters

Water quality parameters (except transparency and chlorophyll-*a*) did not differ significantly among the treatments (Table 2). The mean values of water temperature were more or less close to the 27ºC in each treatment. The recommended suitable range of temperature for prawn culture is ranged from 21.9 ºC to 33.5 ºC (Fair and Foftner, 1981). Dissolved oxygen (DO) concentration in different treatments varied from 4.09 to 7.22 mg l^{-1} was more or less similar to

the findings of Asaduzzaman *et al.* (2005) who recorded DO ranged from 1.2 to 7.2 mg l^{-1}. pH concentration in different treatments varied from 7.20 to 8.0 was within suitable range for *M. rosenbergii* from 7.5 to 8.5 stated by Jia-Mao *et al*. (1988).

Water transparency ranged from 24 to 41.46 cm which were more or less similar with the findings of Rahman (2005) and Kunda *et al.* (2008) who recorded values ranging from 15 to 45 cm and 28.22 to 33.85 cm, respectively. The mean values of chlorophyll-*a* were 153.35 ± 11.22 µg l^{-1}, 182.53 ± 14.15 µg l^{-1} and 185.86 ± 14.76 µg l^{-1} in treatments, T_1, T_2 and T_3, respectively. Transparency was significantly higher in the treatment T_1 and inversely Chlorophyll- *a* value was significantly lower in the treatment T_1. Chlorophyll- *a* is the indicator of pond productivity, which shows an inverse relationship with water transparency (Ahmed, 1993).

Table 2. Mean (± SE, N=15) values of water quality parameters from three treatments

Variables	Treatment			Level of Significance
	T_1	T_2	T_3	
Temperature(^{0}C)	27.05 ±0.21	27.15 ±0.19	27.10 ±0.21	NS
Transparency (cm)	39.34 ± 1.17^a	28.45 ±1.20^b	27.51 ±1.27^b	*
Dissolved oxygen (mg l^{-1})	5.82 ±0.35	5.63 ±0.39	5.62 ±0.33	NS
pH	7.61 ±0.09	7.66 ±0.10	7.60 ±0.08	NS
Chlorophyll-*a* (µg l^{-1})	153.35 ±11.22^b	182.53 ± 14.15^a	185.86 ± 4.76^a	*

NS= Values are not significantly different (*P>0.05*), *Values with different superscript indicate a significant difference at 5% significance level based on Tukey's test

Plankton and benthos population

Plankton population was identified upto genus level. About 38 genera of phytoplankton belonging to Chlorophyceae (19 genera), Bacillariophyceae (10 genera), Cyanophyceae (07 genera) and Euglenophyceae (02 genera) and 12 genera of zooplankton belonging to Crustacea (07 genera) and Rotifera (05 genera) were identified. Plankton (phytoplankton and zooplankton) abundance was significantly lower in treatment T_1 but no significant difference (*P>0.05*) between treatments T_2 and T_3 revealed the utilization of plankton in poly-culture of male prawn with mola. The mean abundance of total benthos during the experiment was 1597.77 ± 63.18 individual m^{-2}, 1645.06 ± 69.74 individual m^{-2} and 1693.92 ± 72.18 individual m^{-2} in treatments T_1, T_2 and T_3, respectively. Chironomidae were the most dominant groups in the present study (Table 3).

Table 3. Mean (± SE, N=15) abundance of plankton (×10^3 cells l^{-1}) and benthos (individual m^{-2}) groups recorded in three treatments

Plankton groups	Treatments			Level of Significance
	T_1	T_2	T_3	
Total phyto-plankton	64.36 ± 8.99^b	108.81 ±12.25^a	105.20 ± 6.95^a	*
Total zooplankton	11.34 ± 2.74^b	22.48 ± 3.38^a	20.53 ± 1.96^a	*
Total plankton	**75.70 ± 11.74^b**	**131.30 ± 15.64^a**	**125.74 ± 8.91^a**	*
Chironomi-dae	678.80 ± 30.85	714.32 ± 31.72	708.82 ± 32.19	NS

Oligochaeta	467.19 ± 18.71	473.31 ± 18.03	490.44 ± 19.40	NS
Mollusca	360.12 ±10.12	362.39 ± 12.92	390.92 ± 12.95	NS
Unidentified	91.66 ± 4.60	95.04 ± 8.73	103.74 ± 8.03	NS
Total Benthos	**1597.77 ± 63.18**	**1645.06 ± 69.74**	**1693.92 ± 72.18**	**NS**

NS= Values are not significantly different (*P>0.05*), *Values with different superscript indicate a significant difference at 5% significance level based on Tukey's test

Production performance of giant freshwater prawn and mola

The mean harvesting weights of prawn were 32.33 ± 1.45 g, 31.66 ± 1.20 g and 25.33 ± 0.88 g in treatments T_1, T_2 and T_3, respectively (Table 4). Mean harvesting weight (g) and weight gain (g) of female prawn (T_3) was significantly lower than that of mono-cultured (T_2) and poly-cultured male prawn (T_1). The statistical analysis showed that the net production of female prawn (492.78 ± 27.39 kg $ha^{-1}120\ d^{-1}$) in treatment, T_3 was significantly lower (*P<0.05*) than the net production of male prawn (613.61 ± 28.59 kg $ha^{-1}120\ d^{-1}$) in treatment T_2, but there was no significant difference (*P>0.05*) between mono-cultured male prawn (T_2) and poly-cultured male prawn (T_3). Gross production and net production of prawn in three treatments are shown in Figure 1. Freshwater prawns are omnivores but mainly bottom feeders and utilize feed provided from outside. So, a large amount of phytoplankton produced in the pond remain unutilized and may cause heavy growth of phytoplankton, thus reduce transparency and depletes dissolved oxygen (Green *et al.,* 1977). Mola clean up phytoplankton and help to retain good water quality without reducing prawn growth and does not compete with prawn for feed. Moreover, mola breeds at least twice a year under natural conditions (Kohinoor, 2000). So, polyculture of prawn with mola maintains the ecological balance of the pond water.

Table 4. Production performance (Mean ± SE) of giant freshwater prawn and mola among different treatments

Variables	Treatments			Level of Significance
	T_1	T_2	T_3	
Giant freshwater prawn				
Mean stocking weight(g)	1.75 ± 0.00	1.75 ± 0.00	1.75 ± 0.00	NS
Mean harvesting weight (g)	32.33 ± 1.45^a	31.66 ± 1.20^a	25.33 ± 0.88^b	*
Mean weight gain (g)	30.58 ± 1.45^a	29.91 ± 1.20^a	23.58 ± 0.88^b	*
Survival (%)	73.98 ±2.89	68.39 ± 2.24	69.60 ± 2.35	NS
SGR (% body weight)	2.15 ± 0.03^a	2.14 ± 0.02^a	1.97 ± 0.02^b	*
FCR	0.72 ± 0.07^b	0.70 ± 0.09^b	2.62 ± 0.07^a	*
Gross production (kg ha^{-1})	715.19 ± 6.97^a	649.52 ± 29.27^a	529.32 ± 28.35^b	*
Net production (kg ha^{-1})	676.34 ± 7.84^a	613.61 ± 28.59^a	492.78 ± 27.39^b	*
Mola				
Mean stocking weight (g)	0.80 ± 0.00	-	-	-
Mean harvesting weight (g)	3.57 ± 0.69	-	-	-
Mean weight gain (g)	2.77 ± 0.69	-	-	-
SGR (% body weight)	1.09 ± 0.15	-	-	-
Gross production (kg ha^{-1})	56.66 ± 4.48	-	-	-
Net production (kg ha^{-1})	46.48 ± 3.87	-	-	-

NS= Values are not significantly different (*P>0.05*), *Values with different superscript indicate a significant difference at 5% significance level based on Tukey's test

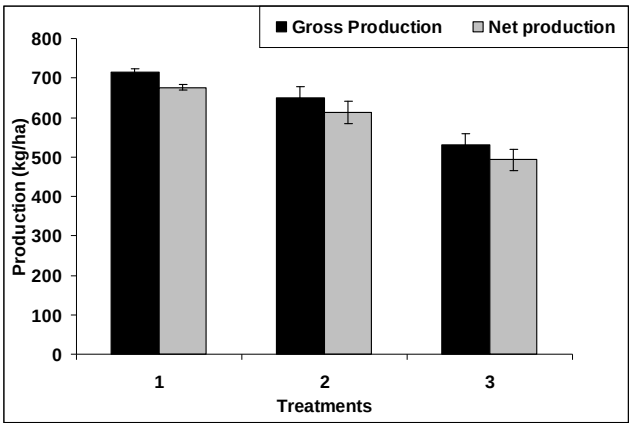

Figure1. Production performance (kg ha^{-1}120 d^{-1}) of giant freshwater prawn

Conclusion

Male prawn showed better growth and production performance than female prawn and the highest gross and net production were recorded in treatment T_1, where all-male prawn were cultured with mola. Therefore, nutrient-dense mola may be stocked as an additional species with giant freshwater prawn that would give higher total production, provide family nutrition as well as generate additional income. It may be concluded that there is a potential for all-male giant freshwater prawn culture with mola in pond and other culture systems.

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