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Cultivation of Prawn in Polyculture with some Species of Indian and Chinese Major Carps

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The freshwater prawn *Macrobrachium rosenbergii* (de Man) was cultivated in polyculture with Indian and Chinese major carps for two successive years. The densities of prawn were 6000,8000 and 10,000 juveniles / ha with a constant fish density of 5,000 fish fingerlings / ha. The fish species were silver carp (35%), catla (15%), mrigal (20%) in the first year and in the second year silver carp, catla, rohu, mrigal, grass carp and black carp in the ratio of 30:15:34:5:15:1, respectively. Highest production of prawn and fish were 122 kg / ha and 4200 kg / ha / yr in the first year and 96 kg / ha and 3945 kg / ha / yr in the second year. The low production of prawn might be hampered by the low temperature. However, cultivation of prawn with Indian and Chinese major carps should be made in overwintering season and low prawn density should be maintained in polyculture system of *M. rosenbergii* with fish.

Key words: *Macrobrachium rosenbergii,* Polyculture, Production and culture system.

Indroduction

The freshwater prawn *Macrobrachium rosenbergii.* (de Man) has a very high potential for aquaculture in Bangladesh. The species has a number of advantages over many other crustaceans (Fujimura 1967, 1972 and 1974). It is a benthophagic omnivore, which makes it a good candidate in the polyculturing system (Parameswarn *et al* 1977). Polyculture of *M. rosenbergii* has been successfully investigated with Indian and Chinese carps in many countries of the world (Malecha *et al* 1981; Buck *et al* 1983; Wohlfarth *et al* 1985).

Prawns are the valuable cash crop and its polyculture with various species of fish has received considerable attention in temperature climates. Polyculturing system of *M. rosenbergii* with other fish species which are exclusively surface feeder and mid-water feeder produces more crops by utilizing the whole water body through improving the ecological stability or possibly through redistribution of food without hampering the growth rate of either the prawn or other fish species, (Tunsutapanich *et al* 1982). In Bangladesh, polyculture of *M. rosenbergii* with carp is a potential area of research at the prevailing context of the carp polyculture system. This is already an on-going practice in different places of Bangladesh (Shah 1991). Presently, the practice is that the farmers stock prawns and fishes without any scientific basis of stocking density, the level being very limited and extensive. There are thus enough scopes for improving the present practice through scientific culture and management. With this end in view, the study was undertaken to see how present system of carps polyculture can be improved through introducing prawn in the system.

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Materials and Methods

The study was conducted for two successive culture periods from December to September and from November to July and these two culture periods are called as first year and second year, respectively. In the first year treatments were carried out with or without prawn under some feeding and fertilization situation with two replications of each, having an area of 0.1 ha for each replications pond. The experimental design is given in Table 1.

In the second year there were five different treatments each with two replications. Out of the five treatments three treatments (T_1, T_2 and T_3) consisted of two different prawn densities with a constant density of fish, the treatments were tested with regard to two different feeds, viz., feed A and feed B under the same fertilized situation. The treatments T_4 and T_5 were adopted as the means to compare the growth of fish under the situation of fish with or without prawn under the same two types of feeding conditions. Hatchery produced seeds were used for the experiment. The experimental design is given in Table 2.

Results and Discussion

The production of fish and prawn as well as total production of each treatment for each year of trial are shown in Table 3. From the first year production, it was seen that out of two treatments, first treatment had given a production of 4,200 kg /

Table 1
First year experimental design

Treatment	Stocking densities and species combination		Feed and feeding rates		Fertilization
T_1	5000 Fish fingerlings / ha		Sesame oil cake	4%	Inorganic fertilizer
	6000 shrimp / ha		Rice bran	40%	(Urea plus TSP 1:1)
	Silver carp	35%	Fish meal	20%	@ 50 kg / ha / month
	Catla	15%	3% Body weight feed daily		
	Rohu	30%			
	Mrigal	20%			
	Prawn 600/pond				
T_2	5000 fish fingerlings / ha		-do-		-do-
	Silver carp	35%			
	Catla	15%			
	Rohu	30%			
	Mrigal	20%			

Table 2
Second year experimental design

Treatment	Stocking densities and species combination		Feed and feeding rates		Fertilization
T_1	Prawn 10,000 / ha		Fish meal	20%	Only inorganic
	Fish 5,000 / ha		Rice bran	50%	fertilizer (Urea & TSP
	Silver carp	30%	Oil cake	30%	1:1) @80 kg / ha
	Catla	15%	@ 3% body weight daily		
	Rohu	34%	(Feed A)		
	Mrigal	5%			
	Grass carp	15%			
	Black carp	1%			
T_2	Prawn	10,000 / ha	Fish meal	10%	Same
	Fish	5,000 / ha	Rice bran	15%	
	Fish species ratio same as T_1		Oil cake	45%	
			Feeding rate same as T_1		
			(Feed B)		
T_3	Prawn	8,000 / ha	(Feed A)		Same
	Fish	5,000 / ha			
	Fish species ratio same as T_1				
T_4	Prawn	Nil	(Feed A)		Same
	Fish	5,000 / ha			
	Fish species ratio same as T_1				
T_5	Prawn	Nil	(Feed B)		Same
	Fish	5,000 / ha			
	Fish species ratio same as T_1				

Table 3

Details of stocking average final attained by each species and the total production of fish and prawn under polyculture of *M. rosenbergii* with fish

Treatment	Details of stocking		Initial weight (g)	No. fish harvest	% survival	Final weight (g)	Contribution to the production (kg)	Total production (kg / ha / yr)
	Species	No.of fish stocked						
T_1	S.Carp	175	24.0	170	97	1358	231	Fish: 4200
(First year)	Catla	75	21.0	72	96	525	38	Prawn: 122
	Rohu	150	13.0	138	92	701	97	
	Mrigal	100	18.0	90	90	607	54	
	Prawn	600	2.5	112	18.6	109	12.20	
T_2	S. Carp	175	24.0	148	84	1291.9	191.20	
	Catla	75	21.0	63	84	497	31	Fish: 3672
	Rohu	150	13.0	125	83	637	79	
	Mrigal	100	18.0	82	82	805	66	
	Prawn	Nil						
T_1	S.Carp	150	23	143	95	1215	173.75	
Feed A	Catla	75	37	62	82	475	29.45	Fish: 3645
	Rohu	170	12	144	84	550.8	79.30	
	Mrigal	25	11	25	100	804	20	Prawn: 75
	G. Carp	75	2.5	70	94	246	52	
Second	B. Carp	5	43	5	100	2080	10	
year	Prawn	1000	5.6	157	15.7	48	7.50	
T_2	S.Carp	150	23	131	87	1233.7	161.61	
Feed B	Catla	75	37	55	73	468	25.74	Fish: 3125
	Rohu	170	12	117	69	565	66.10	
	Mrigal	25	11	25	100	705	17.62	Prawn: 59
	G. Carp	75	2.5	55	73	585	32	
	B. Carp	5	43	5	100	1900	9.50	
	Prawn	1000	5.6	132	13.2	45	5.90	
T_3	S. Carp	150	23	143	95	1315	188.01	
Feed A	Catla	75	37	69	79	535	36.92	Fish: 3945
	Rohu	170	12	138	81	678	93.56	
	Mrigal	25	11	24	96	455	10.92	Prawn: 96
	G. Carp	75	2.5	61	81	890	54	
	B. Carp	5	43	5	100	2200	11	
	Prawn	800	5.6	192	14	50	9.60	
T_4	S.Carp	150	23	141	80	1318	185.84	
Feed A	Catla	75	37	65	60	520	33.80	Fish : 3796
	Rohu	170	12	147	57	476	69.97	
	Mrigal	25	11	25	100	909	23	
	G. Carp	75	2.5	51	68	1000	51	
	B. Carp	5	43	5	100	3200	16	
	Prawn	Nil						
T_5	S. Carp	150	23	138	78	1312	181	
Feed B	Catla	75	37	65	60	495	32.18	Fish : 3565
	Rohu	170	12	144	70	438	63.11	
	Mrigal	25	11	25	100	820	20.50	
	G. Carp	75	2.5	43	57	1191	51	
	B. Carp	5	43	5	100	1750	8.70	
	Prawn	Nil						

S. carp = Silver carp; B. carp = Black carp; G. carp = Grass carp.

Table 4

Treatment wise average values and the range of physico-chemical and biological parameters under polyculture of *M.rosenbergii* with fishes in the two successive years of trial

Year	Treatments	Temperature ˚C	Water transparency (cm)	Dissolved O_2 (ppm)	pH	Hardness (ppm)	Plankton (org./l)	
							Zooplankton	Phytoplankton
Ist year	T_1	18.67 - 29.17	35.5 - 63.4	3.35 - 5.45	7.0 - 8.0	128 - 135	7151 - 10830	13875 - 33850
	T_2	18.67 - 29.17	41.18 - 65.25	2.25 - 5.50	7.3 - 8.5	95 - 130	6983 - 8500	10158 - 30155
2nd year	T_1	9.5 - 34.5	15.4 - 43.0	1.0 - 8.5	6.7 - 9.0	85 - 135	830 - 7600	5430 - 32000
	T_2	9.5 - 34.5	23.0 - 64.0	1.5 - 7.5	6.5 - 8.5	98 - 138	780 - 8300	4380 - 28000
	T_3	9.5 - 34.5	14.0 - 74.0	1.5 - 9.0	6.5 - 9.0	74 - 175	800 - 7500	5080 - 30200
	T_4	9.5 - 34.5	12.0 - 61.0	2.0 - 7.0	7.0 - 8.5	98 - 135	650 - 9500	5220 - 35000
	T_5	9.5 - 34.5	13.5 - 59.0	1.9 - 6.5	6.5 - 8.5	75 - 140	850 - 9320	6430 - 38000

ha / yr of fish plus 122 kg / ha / crop of prawn in polyculture at a stocking density of 6,000 juveniles/ha and 5,000 fingerlings of carps / ha and in the second treatment fish production obtained from ponds without prawn was 3,672 kg / ha / yr which is lower than the production obtained from the first treatment. This low production of fish in the second treatment could be explicable on the basis of the fishes, effected by the argulosis disease which might hampered the total fish production. As compare to the growth of mrigal in the first trial, mrigal showed better performance in these ponds, where prawn was nil. This year trial indicates that the ecological niche of the aquaculture system utilized by the prawn with carps polyculture ponds are not overlapped with niches of other carps, except mrigal. Similar results have also been reported by Tunsutapanich *et al* (1982); Rouse and Stieckney (1982).

In the second year trial out of the three treatments (T_1, T_2 and T_3), the treatment (T_3) had produced the higher production of fish 3945 kg / ha / yr plus 96 kg / ha / crop of prawn where prawn were stocked at 8,000 juveniles / ha and the Feed A was used, having 25.34% protein level. The other two treatments T_1 and T_2 each has produced 3,645 kg / ha / yr of fish plus 75 kg / ha / crop of prawn and 3,125 kg / ha / yr of fish plus 59 kg / ha / crop of prawn, respectively where prawn density was 10,000 juveniles / ha in each treatment and the Feed A, Feed B, respectively were used as supplementary feed. In feed B having 24.5% protein level. Other two treatments T_4 and T_5 each has produced 3,795 kg / ha / yr and 3,565 kg / ha / yr of only fish where prawn was nil and the supplementary feed A and B, respectively were applied. These two treatments were adopted as the means to determine the growth of fishes effected by situation of with or without prawn under two types of feeding conditions. The results of these two treatments T_4 and T_5 indicating that with or without prawn in polyculturing of *M. rosenbergii* with carp no significant loss is caused in total biomass. Similar results have also been cited by Buck *et al* (1983); Cohen and Raianan (1983) and Ahmed *et al* (1996). From Table 3 it was seen that the average growth of individual fish was below marketable size which was the most plausible reason for the high density situation effected by the shallowness of the ponds; the effective depth (1.5m) of ponds was quite low in consideration of the density of fish stocked and due to their higher ratios circumstances in the surface (45%) and midwater region (49%).

The prawn production of 122 kg / ha / crop, 96 kg / ha / crop and the lowest production of 59 kg / ha / crop under the stocking density of 6,000 / ha, 8000 / ha and 10,000 / ha, respectively in the two sucessive years, with a constant density of 5,000 fish / ha; it is seen that the production of *M. rosenbergii* was higher in ponds with lower stocking densities of prawn. Smith *et al* (1978); Willis and Berrigan (1977) and Huner *et al* (1980) recommended that low density culture was feasible where growing season for prawn was 5-6 months. The survival rate of prawn ranged from 13-24% and fish 69-100%. In this study it was also found that prawn survival increased with decreased stocking density. It has been reported by some researcher (Sandifer and Smith 1975; Willis and Berrigan 1977; Brody *et al* 1980). The low survival of prawn could be explicable on the basis of some probable factors such as temperature, stocking density etc.

Considering the shallowness of the ponds that resulted in to the reduced space, food and shelter. The result of the physico-chemical parameters (Table 4) particularly temperature, dissolved oxygen, transparency and pH data explain the low survival rate. During the culture period dissolved oxygen level ranged from 1-8.5 ppm. This confirms more generally, the low level of dissolved oxygen at early in the morning the prawns were observed to move very slowly along the shoreline of the pond. Humayun *et al* (1986) reported that low dissolve oxygen content of water was the most important cause for heavy mortility of prawn. Cohen and Raianan (1983) reported that to get an optimal prawn production, dissolved oxygen level should always be maintained above 4 ppm. On the other hand, culture cycle of the species has been erroneous; the prawn suffer from cold condition very much and as such their culture cycle should not be through cold season. Wohlfarth *et al* (1985) terminated their experiment on polyculture of prawn with fish at the beginning of November, not to expose the prawns to low water temperature, which might be lethal for prawns. During second year culture period of this experiment the atmospheric temperature dropped down to 5.6°C and the water temperature at 7.00 am. was 9.5°C (Table 2); which might be most plausible for heavy mortality of prawn. Sang and Fujimura (1977) cited that *M. rosenbergii* adopts minimum 15°C to maximum 35°C temperature and the maximum growth rate occur near at 31°C. However, the temperature data (Table 2) in the present study were 9.5-34.5°C in the second year trial but in the first year trial the temperature data were in the range of 18-33°C. It can also be noted that low survival of prawn might be plausibly the reason of predation by piscivorous animals such as fox which were available in the research area, as the species is more vulnerable to predation during molting stages.

From the present study, it can be suggested for the next, culture of prawn should be made at overwinter season and the another observation in the polyculture of prawn with six months rearing but at the same time fish can not attain marketable size. It would be advisable that fishes will be stocked at least four months before; than the stocking of prawn. Therefore, further studies are needed to develop the methods and techniques for polyculture of *M. rosenbergii* with fishes.

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