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GROWTH AND YIELD OF *MACROBRACHIUM MALCOLMSONII* (H. MILNE EDWARDS) AND CARPS IN MONO- AND POLYCULTURE IN RURAL AREA

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The study was carried out on mono- and polyculture of freshwater prawn *Macobrachium malcolmsonii* stocked with different size carp seed (*Labeo rohita, Catla catla, Hypophthalmichthys molitrix and Ctenopharyngodon idella)* in tropical village fish ponds of Orissa. Treatment-I (T-I) was stocked with *M. malcolmsonii* juveniles for monoculture. Treatment-II, III and IV were stocked with carp fry, fingerlings and yearlings, respectively with prawn juveniles. *M. malcolmsonii* juveniles were stocked @ 50,000/ha for monoculture and @ 25,000/ha for polyculture. Carp fry were stocked @ 30,000/ha and fingerlings and yearlings each @ 3,000/ha. Prawns and carps were fed @ 3-5% of the body weight daily with commercial feed. Grass carps were fed with chopped cabbage leaves daily *ad libitum*. Prawns and carps were harvested at 195 days of rearing. The survival of carps in T-IV was significantly higher ($P<0.01$) than in T-II and T-III. As stocking size of the carps increased, the final net weight and yield contribution increased. Significant variation ($P<0.01$) in net fish yield was observed among the treatments. In mono culture (T-I) the prawn production was highest (973.02 kg/ha/yr). In polyculture total prawn yield was 481.64-775.38 kg/ha/yr with the contribution of 21.65-58.68% to total yield. T-IV showed better performance in terms of fish and prawn production compared to T-II and T-III, suggesting the suitability of stocking the carp yearlings with prawn juveniles for polyculture.

INTRODUCTION

Freshwater prawn culture has been recognized recently as an alternate eco-friendly and sustainable system for prawn production. Among freshwater prawns *Macrobrachium rosenbergii, M. malcolmsonii*, and *M. gangeticum* inhabiting in natural river systems of India are known to have faster growth. While *M. rosenbergii* is cultivated commercially in certain regions, *M. malcolmsonii* is cultivated only traditionally and the overall picture of culture status is not clear. Although, experiments have been carried out on the monoculture (Mukhopadhyay and Sarangi, 1985; Gopal Rao *et al*., 1986; Kanaujia and Mohanty, 1996; Kanaujia *et al*., 1997) and polyculture (Reddy *et al*., 1988; Durairaj and Umamaheswari, 1991; Rajyalakshmi, 1991; Langer and Somalingam, 1993; Kanaujia and

Mohanty, 1996; Rashid and Behera, 1998), the scientific aquaculture of *M. malcolmsonii* in the farmers' field is limited. To make the culture technologies of *M. malcolmsonii* more appropriate and need based, it is essential to refine the technologies at the scientist-farmer interface in rural area. Present study deals with growth and production of *M. malcolmsonii* and carps under different stocking size of carps at rural front to test and refine the technologies for ease of dissemination and sustainable adoption.

MATERIALS AND METHODS

The study was carried out in the villages of district Khurda, Orissa, India using 12 fish ponds. Monoculture of *M. malcolmsonii* (prawn) was done in 0.05 ha ponds whereas, prawn polyculture with carps in 0.06 ha ponds in triplicates. Ponds were prepared by draining water followed by treating the bottom water with commercially prepared bleaching powder (30% chlorine) @ 50 mg/l to eradicate the predatory and weed fishes (Radheyshyam *et al*., 1993). Pond bottom was exposed to sun for a week. All the ponds were filled with hapa-filtered pond water. To increase productivity of the water, raw cow dung was applied @ 2 tonnes/ha as base manure. After 7 days of manuring, the ponds were stocked with *M. malcolmsonii* juveniles (0.14±0.02 g) @ 50,000/ha for monoculture and @ 25,000/ha for polyculture. In polyculture, carp fry were stocked @ 30,000/ha whereas, fingerlings and yearlings were stocked @ 3,000/ha each (Table-2). In Treatment-I (T-I), the ponds were stocked only with *M. malcolmsonii* juveniles. In Treatment-II, III and IV, the stocking combinations were carp fry + *M. malcolmsonii* juveniles, carp fingerlings + *M. malcolmsonii* juveniles and carp yearlings + *M. malcolmsonii* juveniles, respectively. Prawns and carp fish were fed @ 3-5% of the body weight daily with commercial feed. Chopped cabbage leaves were given *ad libitum* to grass carp. Plastic and earthen pipes were used to serve as shelters. The physico-chemical parameters of pond water were monitored monthly following the methods of APHA (1985). Ponds were harvested after 195 days of culture period. For each pond, one hundred specimens of different size prawn and carps were sampled to get average values. For each treatment three replicates were taken and its mean data presented. Specific growth rate (SGR) was calculated as: SGR=100(lnw2-lnw1)/T), where w1 = initial mean weight, w2 = final mean weight and T = time period (days). Data were subjected to't-test' to determine the significant differences between two means of treatments (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Water pH, free CO_2, dissolved oxygen, total hardness, total alkalinity, P_2O_5 and dissolved ammonia-N were found in the range of 7.4-8.0, 1.8-7.4 mg/l, 6.2-8.5 mg/l, 60-76 mg/l, 60-84 mg/l, 0.01-0.08 mg/l and 0.05-0.37 mg/l, respectively (Table 1). These parameters did not vary significantly among treatments (Banerjea, 1967) and were within the suitable range for *M. malcolmsonii* and carps (Kanaujia *et al*., 1997).

Table 1. Water quality parameters in different experimental ponds used for mono- and polyculture of *M. malcolmsonii*

Treatments	pH	Free CO_2 (mg/l)	Dissolve O_2 (mg/l)	Total hardness (mg/l)	Total alkalinity (mg/l)	P_2O_5 (mg/l)	Ammonia-N (mg/l)
T-I	7.4-7.8	2.0-4.5	6.5-8.0	60-64	76-84	0.04-0.08	0.05-0.32
T-II	7.4-7.8	2.4-6.0	6.5-8.2	62-76	72-84	0.06-0.08	0.05-0.36
T-III	7.8-8.0	1.8-5.0	6.5-8.5	60-68	60-84	0.04-0.06	0.05-0.37
T-IV	7.6-7.8	2.4 -7.4	6.2-8.0	60-64	68-80	0.01-0.08	0.07-0.27

The male:female ratio ranged from 1:3 to 1:6 in harvested prawns. Production of females were markedly higher than males (Smith *et al*., 1978, 1980, 1981, 1982; Smith and Sandifer, 1980; Sandifer *et al*., 1982; Karplus *et al*., 1986; Kanaujia *et al*., 1997). There was marked heterogeneity in the growth of prawns. The growth of males was higher than females. The larger prawns were 5.5-7.6 times higher than smaller ones. Similar growth pattern was reported in *M. rosenbergii* by Wohlfarth *et al*. (1985), Karplus *et al*. (1986), Biswas *et al*. (1992) and Padmakumar *et al.* (1992) and, in *M. malcolmsonii* by Kanaujia *et al.* (1997). Such heterogeneity in growth might be associated with genetic differences, hatching/metamorphosis age (Smith *et al.,* 1982), competitive situation in cases of limited space and food, social hierarchy and territoriality (Kurup, 2004).

The stocking and harvesting details of *M. malcolmsonii* is presented in Table 2. In monoculture of *M. malcolmsonii,* the survival was 38.56% at stocking density of 50,000/ha, which was higher than that reported by Kanaujia *et al.* (1997) (25.7-31.6%) at similar density. They further reported 49.8-52.3% survival of *M. malcolmsonii* at 30,000/ha stocking density but in present investigation the survival was relatively poor (34-49%) even at 25,000/ha stocking density probably due to the presence of carps under polyculture. Among the treatments, prawn survival varied. In treatment-II, the prawn survival was significantly higher ($P<0.01$) than in T-I and T-IV. The survival in T-III was significantly higher than T-IV ($P<0.01$) and T-I ($P <0.05$). With decrease in survival of *M. malcolmsonii,* the growth increased. In polyculture, the final average weight of *M. malcolmsonii* (49.82±16.6 g) in T-IV was significantly higher ($P<0.05$) than T-II and T-III, probably due to low survival as has been recorded by Kanaujia *et al.* (1997).

Specific growth rate (SGR %) of *M. malcolmsonii* differed among the treatments (Fig. 1). In T-IV, the SGR was highest (2.11%). In monoculture (T-I), the SGR was 1.83%, being higher than T-II and T-III. The higher SGR and final weight of *M. malcolmsonii* in T-IV were probably due to the presence of *C. idella* which were fed with cabbage leaves and

the residual feed materials including grass carp faeces might have enriched the detritus food chain for prawn, which was lacking in T-II and T-III.

Table 2. Stocking and harvesting details of freshwater prawn *M. malcolmsonii* under different treatments (T-I = prawn, T-II = prawn+carp fry, T-III = prawn+carp fingerlings, T-IV = prawn+carp yearlings)

Treatment	Area (ha)	Stocking details			Harvesting details				Net wt. (kg)	Yield rate (kg/ha/yr)
		No.	Av. wt. (g)	Total wt. (kg)	Survival (%)	Days	Av. wt. (g)	Total wt. (kg)		
T-I	0.05	2500	0.14 ±0.02	0.35	38.56 ±1.5	195	28.21 ±6.8	26.70 ±6.8	26.35 ±5.7	973.02 ±209.2
T-II	0.06	1500	0.14 ±0.02	0.21	49.0 ±2.2	195	25.17 ±7.4	18.16 ±7.4	17.95 ±4.8	552.20 ±146.8
T-III	0.06	1500	0.14 ±0.02	0.21	44.67 ±1.4	195	23.28 ±10.2	15.86 ±10.2	15.65 ±7.4	481.64 ±229.1
T-IV	0.06	1500	0.14 ±0.02	0.21	34.0 ±1.8	195	49.82 ±16.6	25.41 ±3.49	25.2 ±4.23	775.38 ±144.79

M. malcolmsonii yield varied among treatments. In monoculture, the net production was 973 kg/ha/yr, which is higher than the previous recorded production of 545 kg/ha/yr (Rajyalakshmi *et al.*, 1983), 371.6-421.7 kg/ha/yr (Mukhopadhyay and Sarangi, 1985) and 534.2-690.4 kg/ha/yr (Gopal Rao *et al.*, 1986); however, it is comparable to the records (880-1130 kg/ha/yr) of Kanaujia *et al.* (1997). In polyculture, prawn yield ranged from 481.64 to 775.38 kg/ha/yr which is considerably higher than previous production levels of 327 kg/ha/yr reported by Rao *et al.* (1979) and of 20-170 kg/ha/yr reported by Thangadurai (1992).

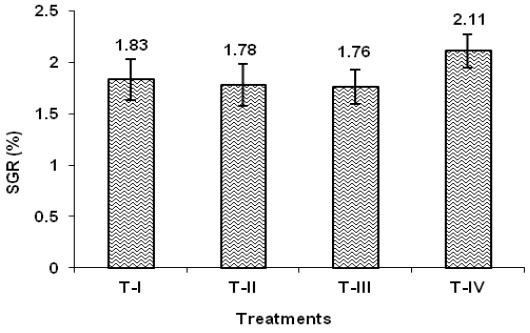

Fig. 1. SGR (%) of *M. malcolmsonii* in mono- and polyculture with carps

Stocking and harvesting details of carps under different treatments are presented in Table 3. Treatment-II resulted in 35±1.6% survival in *C. catla,* and 30±0.8% in *L. rohita.* The low survival of fish may be due to the fact that ponds were stocked with small size seed (fry). In treatment-III (stocked with fingerlings), the carp survival was 88±1.4% in *C. catla,* 87.5±0.9% in *L. rohita* and 94.00±1.2% in *H. molitrix,* whereas in treatment-IV (stocked with yearlings), the

survival of *C. catla, L. rohita, H. molitrix* and *C. idella* was 98±0.5, 92±0.5, 94.0±1.2 and 96.67±0.2%, respectively.

It is well known fact that *C. catla* grows faster than other Indian major carps. It was true in present study too and its yield contribution was higher in T-II (87.86%) and III (37.68%). Whereas, in T-IV the highest contribution was by *C. idella* probably due to lower stocking density. The yield contribution of *H. molitrix* and *C. catla* was nearly equal (Table 3) in T-IV. Due to low stocking density and feeding with cabbage leaves, the growth of *C. idella* was greatest resulting in maximum yield contribution.

Table 3. Stocking and harvesting details of freshwater fish under different treatments (T-II = prawn+carp fry, T-III = prawn+carp fingerlings, T-IV = prawn+carp yearlings)

Treatment	Area (ha)	Spp.	Stocking details			Harvesting details				Yield contribution (%)	Net yield (kg/ha/yr)
			No.	Av. wt. (g)	Total wt. (kg)	Survival (%)	Days	Av. wt. (g)	Total wt. (kg)		
T-II	0.06	C	1000	0.6 ±0.02	0.60	35 ±1.6	195	50.5 ±3.0	17.68 ±1.5	87.86	341.6 ±4.1
		R	800	0.2 ±0.04	0.16	30 ±0.8		10.5 ±1.27	2.52 ±0.4	12.14	47.2 ±1.4
T-III	0.06	C	50	3.8 ±0.41	0.19	88 ±1.4	195	620 ±46.86	27.28 ±1.0	37.68	451.5 ±4.4
		R	80	2.7 ±0.17	0.22	87.5 ±0.9		225 ±13.94	17.50 ±1.1	24.04	288.0 ±2.1
		SC	50	4.0 ±0.19	0.20	84 ±1.3		660 ±7.49	27.72 ±1.4	38.28	458.67 ±2.5
T-IV	0.06	C	50	225 ±4.91	11.25	98.0 ±0.5	195	1156.8 ±53.07	56.68 ±2.12	27.24	757.17 ±90.86
		R	50	200 ±5.94	10.00	92.0 ±0.5		806.37 ±31.08	30.09 ±1.63	14.46	334.83 ±16.38
		GC	30	250 ±5.20	7.5	96.67 ±0.2		2238.94 ±63.52	64.93 ±1.54	31.20	957.17 ±24.82
		SC	50	220 ±3.97	11.00	94.0 ±1.2		1200 ±17.54	56.40 ±1.2	27.10	756.67 ±12.92

C = *Catla catla*, R = *Labeo rohita*, SC = *Hypophthalmichthys molitrix,* GC = *Ctenopharyngodon idella*

There was highly significant variation ($P<0.01$) in net fish yield among the treatments. Maximum fish yield (2805.84 kg/ha/yr) was in the ponds stocked with yearling. Carp production in prawn poly-culture with yearling and fingerling were higher than the earlier records of 640 kg/ha/yr carp production by Langer and Somalingam (1993) and comparable to 1328-2812 kg/ha/yr by Durairaj and Umamaheshwari (1991).

However, with fry stocking, production was lesser than the previous records. Present study shows superiority of stocking yearling, fingerling and fry in descending order in terms of production in prawn polyculture.

In the present study, an average yield of 3,581 kg/ha/yr with the yearling stocking in T-IV was higher than the previous records in rural area of the region (2,256 kg/ha/yr by Radheyshyam and Tripathy, 1992; 2,279.5 kg/ha/yr by Radheyshyam, 1998; 3,200 kg/ha/yr by Radheyshyam, 1999). The carp and prawn production together was highest in T-IV (Fig. 2) due to higher contribution of carp production (78.35%). Prawn production contributed to 21.65-58.68%. The contribution of carp production increased with increasing size of carp seed.

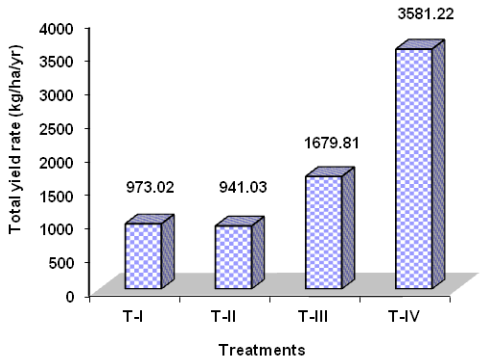

Fig. 2. Production of prawn and fish together under mono- and polyculture

Present investigation at scientist-farmer interface in rural area concludes the superiority of stocking yearlings of compatible carp seed over fingerling and fry in terms of survival, growth and production in prawn polyculture.

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