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Survival, growth and production of *Penaeus monodon* and *P. indicus* at different density combinations with milkfish

F.D. Apud and S.H. Benagua

Penaeus monodon (9.21 g ABW) and *Penaeus indicus* (2.34 g ABW) juveniles were stocked and reared for about 3 months in 500 m² earthen ponds at different density combinations with *C. chanos*. Density ratios for *P. monodon* and *P. indicus* were as follows: A = 300:100/pond; B= 200:200; C = 100:300; D = 400 *P. monodon* and E = 400 *P. indicus*. *C. chanos* was stocked at a constant density of 100/pond.

The percentage survivals for *C. chanos*, *P. Indicus* and *P. monodon* are summarized in Table 1. Analysis of variance showed that there was significant difference at the 5% level for survival among treatments of *P. monodon*. There was no significant difference in *C. chanos* survival among treatments.

The presence of either *P. monodon* and *P. indicus* or both at any density ratio did not affect significantly the *C. chanos* survival. The over-all rate of about 92% for *C. chanos* was comparable with that achieved in a polyculture system of Eldani and Primavera, (1981) with 93.8 % and Pudadera (1980) with 87.2%. In treatments without prawns, Pudadera (1980) got milkfish survival of 95 %. Most of milkfish monoculture practitioners get as much rate or normally more than 90% survival. Results of the study of Eldani and Primavera (1981) showed that the addition of prawn increased milkfish growth and production, and controlled *Chironomid* larvae abundantly present in the earthen ponds during the culture period. Likewise, Gunderman and Popper (1977) reported that *P. monodon*, *P. merguensis* and *P. indicus* were observed feeding on *Chironomous* larvae in Fiji which resulted in the absence of the larvae several weeks after stocking. However, in this study only a few chironomid larvae were observed during the culture period. This study indicated that milkfish survival is not influenced in polyculture with shrimps and prawns.

Table 1. Summary of stocking, harvest and production of *P. monodon* and *P. indicus* at different density ratios with *C. chanos* in 500 m² earthen ponds.

Treatment	Species	Stocking density (No./500 sq m)		Mean Survival Rate(%)	Mean body weight (g)		Mean weight gain(g)	Gross Production (kg/ha/crop)
		Initial	Final		Initial	Final		
A	<i>P. monodon</i>	300	40	13.3*	9.21	16.0	6.8	12.4
	<i>P. indicus</i>	100	52	52.0 [†]	2.34	16.84	14.5	17.6
	<i>C. chanos</i>	100	96.3	96.3	104.5	268.1	163.6	516.4
Total		500	188.3					546.4
B	<i>P. monodon</i>	200	48	24.0*	9.21	29.0	19.8	27.0
	<i>P. indicus</i>	200	166	83.0 [†]	2.34	12.0	9.7	40.8
	<i>C. chanos</i>	100	94.3	94.3	104.5	251.9	147.4	475.1
Total		500	208.3					542.9
C	<i>P. monodon</i>	100	61.3	61.3*	9.21	18.5	19.3	22.7
	<i>P. indicus</i>	300	192	64.0 [†]	2.34	14.0	11.6	53.4
	<i>C. chanos</i>	100	89.3	89.3	104.5	265.3	160.8	473.8
Total		500	342.6					549.9
D	<i>P. monodon</i>							
	<i>P. indicus</i>	400	188	47.0 [†]	2.34	13.1	10.4	49.2
	<i>C. chanos</i>	100	86.3	86.3	104.5	265.3	160.8	457.9
Total		500	274.3					507.1
E	<i>P. monodon</i>	400	48.0	12.0*	9.21	12.0	2.79	10.7
	<i>P. indicus</i>							
	<i>C. chanos</i>	100	93.6	93.6	104.5	258.4	153.9	483.7
Total		500	141.6					495.2

*[†]Significantly different values at P < 0.05.

The significant differences in the survival of *P. monodon* indicated certain effect of density and density ratio. *P. monodon* survivals as shown in Table 1 were inversely related to stocking density. *P. indicus* survival appeared to have been partly influenced by the density of *P. monodon*. It was highest in Treatment B with the lowest number of *P. monodon*. It was therefore indicated by the above results that intraspecific and interspecific competition did occur and were reduced with the reduction in stocking rate. Increase in the density of *P. monodon* had a negative effect on its survival as well as the survival of *P. indicus*.

The lowest survival (12%) of *P. monodon* was obtained in Treatment E and was consistent with the average prawn survival of 10-50% reported by Delmendo and Rabanal (1956) in a commercial culture of prawn with milkfish and other finfish. No dead prawns were recovered from all ponds. High mortality of *P. monodon* and *P. indicus* may be related to high stocking density (8000/ha). As such small moulting penaeids are susceptible to predatory activity of other non-moulting and starving penaeids. Marte (1980) described *P. monodon* as more of a predator of slow-moving benthic macroinvertebrates and reported that 85% of ingested food of 167 wild and adult *P. monodon* consisted small crabs, shrimps and molluscs. Hall (1972) as cited by Wickins (1976) reported that in general, small crustaceans, polychaetes, algae and detritus are the food of *P. monodon*, *P. indicus*, *P. merguensis* and *Metapenaeus* species. Milkfish and penaeids have different food preferences so food competition was not present in the experiment. Vicencio (1977) reported that milkfish fry and fingerlings prefer phytoplankton as food while post fingerlings and marketable size fish feed on plankton and filamentous green algae.

The mean weight gains for *C. chanos* were almost similar in all treatments, the highest (163.6 g) was achieved in Treatment A and the lowest (147.4) was recorded in Treatment B. Pudadera (1980) indicated that there exists a competition between *C. chanos* and *P. monodon* although negligible for 2,000 *C. chanos*, with 6,000 *P. monodon*/ha with a competition index of 0.03 but increased to 0.15 when *C. chanos* were stocked at 4,000/ha.

The mean weight gains for *P. indicus* and *P. monodon* indicated some degree of inter and infra-specific competition. The mean weight gain for *P. indicus* did not vary as much as *P. monodon*, although results suggest some direct influence of stocking rate. The latter gained more weight (19.8 g) at 4,000/ha with 4,000/ha of *P. indicus*. At 8,000/ha, *P. monodon* net weight gain was low (2.79 g) without *P. indicus*.

C. chanos productions in kg/ha/crop were similar in all treatments ranging from 457.9 kg (Treatment D) or an average of 481.4 kg. This rate was relatively higher than that achieved by Eldani and Primavera, (1981) 322.3 kg/ha/crop and 382.6 and Pudadera, 1980 (374 kg/ha/crop and 388.1) in a polyculture system with *P. monodon* at 4,000-8,000 and 6,000 prawn/ha, respectively. At three croppings a year such production would reach as much as 1.4 tons/ha which is bigger than our national average of 600-700 kg in monoculture system.

Table 2. Competition index between *P. monodon* and *P. indicus* at different density combinations for a period of 3 months.

Density Combination	Net production (kg/ha)		Competition Index (CI)
	Monoculture	Polyculture	
A. Effect of <i>P. indicus</i> on <i>P. monodon</i>:			
Negative values indicate no competition and therefore <i>P. indicus</i> had no effect on <i>P. monodon</i>			
1. 2000 <i>P. indicus</i> 6000 <i>P. monodon</i>	10.7	12.4	-0.159
2. 4000 <i>P. indicus</i> 4000 <i>P. monodon</i>	10.7	12.4	-1.52
3. 6000 <i>P. indicus</i> 2000 <i>P. monodon</i>	10.7	22.7	-1.12
B. Effect of <i>P. monodon</i> on <i>P. indicus</i>:			
Positive values indicate competition at high density of <i>P. monodon</i> and therefore unfavorable effect on <i>P. indicus</i> .			
1. 2000 <i>P. indicus</i> 6000 <i>P. monodon</i>	49.2	17.6	0.64
2. 4000 <i>P. indicus</i> 4000 <i>P. monodon</i>	49.2	40.8	0.17
3. 6000 <i>P. indicus</i> 2000 <i>P. monodon</i>	49.2	53.4	-0.09

Competition indices are shown in Table 2. On the effect of *P. indicus* on *P. monodon* competition indices were -0.159, -1.52 and -1.12 for Treatments A, B & C, respectively. These negative values indicate absence of competition between *P. indicus* and *P. monodon*. On the effect of *P. monodon* on *P. indicus* the competition index was 0.64, 0.17 and -0.09 for Treatments A, B and C. The positive values indicate competition at high density of *P. monodon*. However, a negative value of competition index was obtained at lower density (2,000 *P. monodon*/ha).

While total gross productions for *C. chanos* were relatively higher than our national average and that of the other two above experiments, added production derived from *P. indicus* and *P. monodon* seems considerable. Further studies on higher density ratios and probably with feeding and economic consideration would be of great help to the development of this kind of fish-pond management systems.

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