



## A preliminary trial on polyculture of three Indian penaeid shrimps

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### Abstract

To find out the compatibility of three penaeid shrimps, namely, *Penaeus monodon*, *P. semisulcatus* and *Fenneropenaeus indicus* for polyculture, and to compare their growth rates under similar environmental conditions, a preliminary polyculture trial was carried out in a 0.08 ha earthen pond by stocking their seeds at the rate of 6.25 post larvae /m<sup>2</sup>. Hatchery produced post larvae (PL<sub>25</sub>) of *P. monodon* and *P. semisulcatus* and wild post larvae of *F. indicus* were stocked at a ratio of 25:20:5 respectively. Shrimps were fed with pelleted feed No. 1-4 which were gradually increased in quantity and size of the pellets as the shrimp grew in size. On day 70, as mortality was observed for tiger shrimp due to White Spot Syndrome Virus (WSSV) infection, all the shrimps in the culture system were harvested for observations on the infection, and to work out the rates of their survival, growth, production as well as the food conversion ratio (FCR). Production rate and FCR were found at 301 kg/ha and 1.33 respectively. The overall survival rate was 51.22% with variations among the three species; being much higher for *P. semisulcatus* (69.3%) than for the other two species (<37.0%). Growth in total length (TL) and weight (wt.) also varied significantly ( $P < 0.05$ ) among the three species, *P. monodon* registering faster growth (114.5 mm TL/ 11.36 g. wt.) than the other two species; 101.24 mm TL/ 8.8 g wt. and 103.5 mm TL/ 8.1 g wt. for *P. semisulcatus* and *F. indicus* respectively. About 52.0% of the harvested animals of *P. monodon* showed clinical symptoms for WSSV infection such as presence of white spots and patches on carapace whereas none of *F. indicus* and *P. semisulcatus* exhibited any trace of such symptoms, revealing that *P. monodon* was more susceptible to WSSV infection.

**Keywords:** Polyculture, *Penaeus monodon*, *P. semisulcatus*, *F. indicus*, WSSV infection

### Introduction

The black tiger shrimp *Penaeus monodon* Fabricius, the Indian white shrimp *Fenneropenaeus indicus* (H. Milne Edwards) and the green tiger shrimp *Penaeus semisulcatus* De Haan are the cultivable Indian penaeids, of which, the black tiger shrimp is the widely adopted species in aquaculture due to its faster growth and adaptability to a wide range of salinity, from fresh water to sea water (Ravichandran and Pillai, 2004). Though the technology for seed production and grow-out culture are available for the Indian white shrimp (Unnithan, 1985; Silas *et al.*, 1985), the tiger shrimp is widely practiced in brackishwater due to its higher lucrative returns than the white

shrimp. Experimental studies by Maheswarudu *et al.* (1990, 1995, 2007) on seed production and grow-out culture of the green tiger shrimp have revealed the potentiality of this species for aquaculture. Therefore a preliminary trial was carried out in a grow-out culture pond to compare the growth rates of these three species in similar environmental conditions and to find out their compatibility in polyculture and the results are presented here.

### Materials and methods

The present study was conducted at the Marine Fish Farm of the Regional Centre of Central Marine Fisheries Research Institute, Mandapam during October 1999-January 2000 for which, the post larvae (PL<sub>25</sub>) of *Penaeus monodon* and

*P. semisulcatus* were produced in the backyard shrimp hatchery of the same Regional Centre. The postlarvae of *Fenneropenaeus indicus* (size ranging from 20 mm TL to 25 mm TL) were collected from nearby lagoon. An earthen pond of 0.08 ha size was selected and prepared for stocking. Pond was constructed with a sloping bottom and was kept for drying for one month prior to filling with sea water. Required sea water was drawn by pumping from the Palk Bay throughout the experiment. Water depth of 1.0 m was maintained at the deeper zone. Inorganic manures such as superphosphate and urea were applied at the rate of 100 kg/ha and 50 kg/ha, respectively, fifteen days prior to stocking to boost the phytoplankton production and the subsequent zooplankton. Seed of *P. monodon* and *P. semisulcatus* and *F. indicus* were stocked in the ratio 20: 25: 5. The stocking density was 6.25 postlarvae/m<sup>2</sup>. Details of the feed and feeding schedule adopted during the trial are furnished in Table 1. Shrimps were fed with the feed marketed by C.P. Aquaculture Private Ltd. The granular size of feed as well as feed quantity was increased as

periphery of the pond. All such individuals had white spots on carapace and red discolouration of the body, indicating infection by the White Spot Syndrome Virus (WSSV). Therefore, the pond was drained and all the animals of the three species, alive or dead, were collected, segregated species-wise and each individual was examined for clinical symptoms of WSSV infection such as presence of white spots and patches on the carapace. Species-wise and sex wise length and weight measurements were recorded to study the growth. Total feed given during the entire culture period was summed up and the food conversion ratio (FCR) was worked out by dividing the total feed consumed (kg) by the total shrimps harvested (kg). ANOVA single factor analysis was carried out to find out the difference in growth rate in total length and weight of these three species.

### Results

The ambient water temperature in the pond ranged from 26.3 to 28.5°C. The temperature which was 28.0°C at stocking gradually declined to 26.3

Table 1. Feed and feeding schedule adopted during polyculture trial on penaeids for 70 days

Duration of culture period in (days)	Feed No. and size (mm)	Quantity of feed given per day (g)		Total quantity of feed given (kg)
		0600hrs	1700 hrs	
1-7	1, Fine Crumble (0.42 )	100	100	1. 4
8-15	2, Crumble (0.89 )	150	150	2. 4
16-30	3, Crumble (1.41)	200	200	6. 0
31-45	3 and 4 s Pellet (1.8x3.5)	250	250	7. 5
46-60	4-s, Pellet (1.8x3.5)	275	275	8. 25
61-70	4, Pellet(2.3 x 3.5)	325	325	6. 5
Total feed				32. 05

the shrimp grew in size. About 25% of water exchange was provided after 30, 45 and 60 days.

The ambient parameters of the stocked pond such as salinity, temperature, pH, and dissolved oxygen were recorded fortnightly. Sampling for growth was done on the 30<sup>th</sup>, 45<sup>th</sup> and 60<sup>th</sup> day. From day 67 onwards, daily two to three individuals of *P. monodon*, were found dead along the inner

°C on 60<sup>th</sup> day of culture, due to onset of cool climate in the area. However, it was raised to 27.0°C on 70<sup>th</sup> day of culture. The salinity ranged from 32.0 to 33.3 ppt, dissolved oxygen from 5.78 to 9.2 ml/l and pH from 8.5 to 8.8 during the experiment (Table 2).

Out of the total number of 5,000 shrimp seeds

Table 2. Ambient water parameters in the pond in respect of temperature, salinity, dissolved oxygen and pH during polyculture trial on penaeids for 70 days

Parameter	At stocking time	15 <sup>th</sup> day	30 <sup>th</sup> day	45 <sup>th</sup> day	60 <sup>th</sup> day	70 <sup>th</sup> day
Temperature(°C)	28.0	28.4	28.5	26.5	26.3	27.0
Salinity (ppt)	32.0	32.3	32.4	32.3	33.2	33.3
Dissolved oxygen (ml/l)	7.5	7.4	7.4	5.78	6.9	9.2
pH	8.6	8.5	8.7	8.68	8.72	8.8

stocked, only 2,561 shrimps were recovered at the closure of the polyculture trial with a survival rate of 51.2%. But survival rate varied for the three species: 32.2% for *P. monodon*, 69.3% for *P. semisulcatus* and 36.7% for *F. indicus*, Thus the highest survival was for *P. semisulcatus* than for the other two species (Table 3). Out of the total of 24.07 kg shrimp retrieved, 63.3% was constituted

the resultant shrimp yield was 24.07 kg, giving a food conversion ratio of 1.33. This gives an extrapolated production rate of 301 kg/ha.

Nearly 52.0% of *P. monodon* irrespective of the sex showed symptoms of WSSV infection whereas none of the other two species showed any infection of the disease, which is a noteworthy aspect.

Table 3. Number of seed stocked, shrimp harvested and total quantity of shrimp harvested of the polyculture trial conducted for 70 days

Species	No. of seed stocked	No. of shrimp harvested	Survival (%)	Average weight of shrimp (g)	Total weight of shrimp harvested (kg) and percentage
<i>Penaeus monodon</i>	2,000	644	32.2	11.36	7.32 (30.4%)
<i>Penaeus semisulcatus</i>	2,500	1,733	69.3	8.8	15.25 (63.3%)
<i>Fenneropenaeus indicus</i>	500	184	36.7	8.1	1.5 (6.3%)
Total	5,000	2,561	51.22		24.07

by *P. semisulcatus*, 30.4% by *P. monodon* and the rest by *F. indicus*.

At the time of harvest, *P. monodon* attained an average size of 114.5 mm (11.36 g), *P. semisulcatus* 101.24 mm (8.8 g) and *F. indicus* 103.5 mm (8.1 g). Thus a faster growth rate was evident for *P. monodon* than for the other two species. Mean daily growth rate was 1.44 mm (0.16 g) for *P. monodon*, 1.29 mm (0.12 g) for *P. semisulcatus* and 1.15 mm (0.115 g) for *F. indicus*. The differences in growth rates between the three species are quite significant [(Total length; F =139.23 and P = 1.0092E-08) (Weight; F = 47.35 and P =1.82E-06)]. Females grew faster than males in all the three species (Table 4). The shrimps were fed 32.05 kg feed in total during the course of this study and

## Discussion

The result of the present study shows the compatibility of these three species of penaeids for polyculture, as they grew together well up to 70 days under similar environmental conditions. The present record of growth in *P. semisulcatus* was faster (0.12 g/day) when compared to its earlier monoculture record of 0.066 g/day by Nandakumar (1982). The survival rate among the three species at 32-33 ppt salinity seems to vary significantly, being higher for *P. semisulcatus* than for the other two species namely *P. monodon* and *F. indicus*. Paul Raj and Sanjeev Raj (1982) observed low survival at salinity 35 ppt for *F. indicus* and *P. monodon* than for *P. semisulcatus*, indicating that the former two penaeid species can tolerate less saline conditions for culture than *P. semisulcatus*.

Table 4. Growth performance of *P. monodon*, *F. indicus* and *P. semisulcatus* in polyculture trial conducted for 70 days

Species	At stocking time	30 <sup>th</sup> day	45 <sup>th</sup> day	60 <sup>th</sup> day	Pooled	70 <sup>th</sup> day Male	Female
<b><i>P. monodon</i></b>							
Mean total length (mm)	13.48±0.95	60.16±9.95	81.88±7.55	96.64±13.12	114.53±11.41	112.2±11.48	116.41±11.14
Mean weight (g)	0.03	2.32	5	8.6	11.36	11.25	11.45
<b><i>P. semisulcatus</i></b>							
Mean total length (mm)	10.37±0.8	53.3±4.8	78.43±5.5	87.7±7.39	101.24±3.98	99.2±2.1	103.86±3.2
Mean weight (g)	0.02	1.4	4.6	6.4	8.8	8.2	9.0
<b><i>F. indicus</i></b>							
Mean total length (mm)	22.95±1.7	60.5±5.4	78.5±4.9	95.4±6.1	103.5±5.8	100.46±5.2	105.48±6.35
Mean weight (g)	0.05	1.7	4.5	6.7	8.1	7.8	8.0

This is in confirmation to the earlier reports by Maheswarudu *et al.* (1996) and Rao and Kathirvel (1971) on *P. semisulcatus*, indicating the suitability of this species for farming in culture systems of relatively higher saline (> 20 ppt) conditions. Studies on growth and survival of postlarvae and juveniles of these three species at different salinities also showed differential growth. Among the three species, *P. monodon* showed faster growth than the other two species (Paul Raj and Sanjeev Raj, 1982).

Incidence of WSSV both in the wild and cultured *P. monodon* was reported by Chakraborty *et al.* (2002) and Vaseeharan *et al.* (2003). Histopathological study on *P. monodon* from culture ponds in Andhra Pradesh showed the existence of multiple viral infections by Yellow-Head Virus (YHV), Monodon Baculo Virus (MBV) and Infectious Hypodermal Haematopoietic Necrosis Virus (IHHNV) besides WSSV (Madhavi *et al.*, 2002). Vaseeharan *et al.* (2003) reported existence of WSSV in wild *F. indicus* along the southeast coast of India but not in cultured shrimps from any where in India. This may be due to replacement of *F. indicus* by *P. monodon* in the semi-intensive culture that was practiced in early nineties due to higher economic returns. The experimental study challenging postlarvae (PL<sub>28</sub>)

of *P. monodon*, *P. japonicus* and *P. semisulcatus* with WSSV revealed that *P. monodon* is more susceptible to WSSV than *P. japonicus* and *P. semisulcatus*, the last mentioned species being much less susceptible (Chen *et al.*, 2004). In the present polyculture experiment, infection and subsequent mortality in *P. monodon* reveal that *F. indicus* and *P. semisulcatus* are more resistant to WSSV in grow out culture.

Thus the present study confirm that among three species of penaeids, *P. monodon* grow faster than other two species, but *P. monodon* is more susceptible to WSSV than *F. indicus* and *P. semisulcatus*.

#### Acknowledgement

The authors are grateful to Dr. N. G. K. Pillai, Director, Dr. E. V. Radhakrishnan, Head of the Crustacean Fisheries Division, Dr. V. S. Kakati, Principal Scientist and Project Leader, CMFRI for providing facilities and for their encouragement. We are thankful to Shri M. R. Arputharaj, A. Ramakrishnan and A. Vairamani for their technical service rendered during the study.

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Received: 11 April 2008

Accepted: 16 July 2008