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Culture of *Penaeus monodon* (Fabricius) by Using Cyclop-Eeze Feed

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Abstract: The culture of shrimps received maximum importance due to its unique taste, high nutritive value and persistent demand in world market. In the present study an attempt has been made to culture the giant tiger shrimp, *Penaeus monodon* in ten ponds each with 0.5 ha near Mahendrapalli village of Nagai district in Tamil Nadu, India. In 5 ponds the seeds were stocked in high stocking density (15/ m^2) and remaining 5 ponds in low stoking density (8 / m^2). In both the cases, the Cyclop-eeze feed was mixed with Cp feed and provided to the seeds and survival was calculated and compared. The salinity of the ten ponds was ranging between 10–26 ppt and pH was 7.7 to 8.4. Minimum 3.3 ppm dissolved oxygen and maximum 4.2 ppm was recorded during the culture period. The temperature was ranging between 25 to 31ºC and the transparency was 25 to 45 cm. Harvesting was done in low density ponds (G1,G2,G3,G4&G5) at DOC 120 &121 and high density ponds (H1,H2,H3,H4&H5) it was harvested at DOC (Days of culture) 140 and 141. Average body weights of the low density ponds were 36.5 g and high density ponds were 27.2 g. Highest survival (97 %) was recorded in low density ponds and the lowest survival was (92 %) recorded in high density ponds. Maximum production was reported in low density ponds (1,416 Kg / 36.5 g / 121doc) and minimum production was observed in high density ponds (1,877 kg / 27.2 g / 141 doc). The maximum amount of feed was consumed by the shrimps in high density ponds (3,190) and minimum was in low density ponds (1,840). So the FCR (Food conversion ratio) for low density ponds were 1.3 and high density ponds were 1.7. Maximum net profit was obtained from low density ponds (Rs. 1, 92,480) and minimum was in high density ponds (Rs. 68,416). so it is confirmed that 8/m^2 is an ideal stocking density for the culture of *P. monodon* as evidenced from the high net profit (Rs. 1, 92,480). To get this profit, proper nursery stocking, feeding with Cyclop-eeze feed, proper water quality management and feed management is essential.

Key words: *Penaeus monodon*, cyclop eeze feed, FCR, DOC, stocking and harvest

INTRODUCTION

In India, shrimp culture has grown by leaps and bounds and the industry generated huge revenue in terms of foreign exchange, lot of employment and uplifted the living standards of many people involved directly or indirectly with the industry and reduction of over exploitation of natural resources and food security in tropical and sub-tropical regions (Ramanathan *et al*., 2005). In general, the knowledge on suitable feeds which support on growth is lacking. Since feed cost ranges from 50–70% of the total variable costs of production in aquaculture. It would be highly desirable to develop an efficient feed to improve the profitability. In India, at least 10 potential penaeid species are available for the coastal aquaculture. However, *Penaeus monodon* is the only one species cultured and it constitutes about 95–99% of total farmed shrimp production of the country. There is no doubt about the suitability of *P.monodon* for farming as a candidate species with highest growth rate and high market value. The culture of shrimp received maximum importance due to its unique taste, high nutritive value and persistent demand in world market. In India, aquaculture industry is growing at an alarming rate surprising some major hurdles (disease out break and pollution) during its development. The higher stocking densities and poor water quality management might be the reasons for disease outbreak. So sustainable shrimp farming is need of the hour to overcome the above said problem. In the present study Cyclop-eeze feed was used from nursery stage to the end of the culture which was compared with different stocking density ponds.

MATERIALS AND METHODS

The farm is located on the northern bank of Kollidam estuary in Mahendrapalli village. The farm is situated about 15 km away from Kollidam. The southern side of the farm is elevated to a height of 4.0 m from Uppanar estuary. The total area covered is 5.5 ha of which water spread is about 5.0 ha. Totally ten ponds are there and each culture pond size is .5 ha. Initially all the ponds of the present study was allowed to dry and crack to increase the capacity of oxidation of hydrogen sulphide and to eliminate the fish eggs, crab larvae and other predators. Then pond bottom was scrapped 2 to 4 cm by using a tractor blade to avoid topsoil. Then the pond bottom was ploughed horizontally and vertically a depth of 30 cm to

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remove the obnoxious gases, oxygenate the bottom soil, discolouration of the black soil to remove the hydrogen sulphide odour and to increase the fertility. The soil pH was recorded in the ponds with the help of cone type pH meter. The average pH was calculated from the collected data and required amount of lime was applied to neutralize the acid soil condition and increases the availability of nutrient.

Water culture is one of the important processes during the culture period. In deed, if the PLs are stocked into a pond with poor algal populations, they will become stressed. That not only greatly reduces PL growth, but weakens the animals, making them much more prone to disease and subsequent death. For blooming, the pond was fertilized with inorganic or organic fertilizers.

The initial water levels in all ponds were maintained at 70 cm level. The organic fertilizers such as rice bran; groundnut oil cake, dry cow dung and yeast were soaked over night and applied the extract to all ponds. The same procedure was continued for three days. After three days the water colour turned to light green. Then water level was raised to 100 cm of the ponds and added urea and super phosphate to improve the primary production. Fertilization enhanced the optimal algal bloom in the ponds and the transparencies in the ponds were ranged from 33 to 36 cm. During the water culture, chain dragging was done daily before stocking of seeds.

Four numbers of paddle wheel aerators of 1 hp Taiwan made were provided per pond. Aerators placed 5 meters from the dike, about 30 –40 m distance from each other. They were used to create the water current for the accumulation of black soil and waste in the center of the pond and also to increase the dissolved oxygen in the water column.

Nursery stocking in grow out ponds: The *P. monodon* (PL16 pass the PCR test and stress test) seeds were purchased from Tropical biomarine hatchery, Mahabalipuram and were transported in oxygenated double-layered polythene bags (Cyclop-eeze feed was given along with seeds during packing) with crushed ice packs between inner and outer covers of the bag and packed in a carton. The seeds were brought to the farm site and bags were kept in the pond water for some time to adjust the temperature.

The nursery area used for seed stocking was usually 5 to 10% of the total pond area. Due to this less area the Cyclop-eeze feed can easily reach the post larvae. Then the pond water was added slowly into the seed bag to adjust the salinity and pH. During the acclamations time also Cyclop-eeze feed was provided to the post larvae. Subsequently the seeds were released slowly into the nursery section. The stocking density per pond was (G1, G2, G3, G4 and G5) 8/m^2 (40,000 PLs / pond) and (H1, H2, H3, H4 and H5) 15/ m^2 (75,000PLs / pond) respectively. The post larvae after brief period (6 days) in the nursery area were released in to the grow out ponds.

Application of Cyclop-eeze feed: After seed stocking in nursery section, the Cyclop-eeze mixed with the feed for every meal. After 6th day, the dosage of Cyclop-eeze mix was varied for high and low density ponds (Tables 1, 2 and 3).

Table 1: Dosage of Cyclop-eeze (for 1 lakh seed)

Days of culture	Ponds (G1,G2,G3,G4,G5&G6) Ponds (H1,H2,H3,H4,H5&H6)			
	6am (g)	11am (g)	5pm (g)	10pm (g)
1	80	80	80	80
2	90	90	90	90
3	100	100	100	100
4	100	100	100	100
5	100	100	100	100
6	100	100	100	100

Table 2: Cyclop-eeze dosages for the stocking density of 8 / m^2 Ponds (sugar used as a binder)

Days of culture	Ponds (G1,G2,G3,G4,G5&G6)			
	6am (g/kg)	11am (g/kg)	5pm (g/kg)	10pm(g/kg)
7-10	10		10	
11-15			10	10
16-20			10	10
21-30				10
31-40				10
41-50	10		10	10
51-60	10		10	10
61-70			10	
71-80			10	
81-90			10	10
91-100			10	10
101-110	10	10	20	20
111-120	10	10	20	20

Table 3: Cyclop-eeze dosages for the stocking density of 15 / m^2 Ponds (sugar used as a binder)

Days of culture	Ponds (H1,H2,H3,H4,H5&H6)			
	6am(g/kg)	11am (g/kg)	5pm (g/kg)	10pm(g/kg)
7-10	10		10	
11-15			10	10
16-20			10	10
21-30				10
31-40				10
41-50	10		10	10
51-60	10		10	10
61-70			10	
71-80			10	
81-90			10	10
91-100			10	10
101-110	10	10	20	20
111-120	10	10	20	20
121-130	10	10	20	20
131-140	10	10	20	20

Water quality management: The following water quality parameters were recorded regularly for all the ponds. The water level was measured by using a standard scale with cm marking. The water salinity was measured by using a hand refractometer (Erma-Japan). The pH of the pond water was measured by using electronic pH pen manufactured by Hanna Instrumental Company, Japan. Water temperature was measured in the pond itself using a standard centigrade thermometer. The dissolved oxygen was estimated by dissolved oxygen meter. Transparency was measured in terms of light penetration using a secchi disc.

Water exchange: During the first 3-4 weeks of culture, water exchange is not required. Water was exchanged five days once or depends upon the water and shrimp quality. The purpose of water exchange is to maintaining water quality and also to stimulate moulting of the shrimp, resulting in acceleration of growth and production.

Feed management: Feed management plays a major role in the shrimp culture. CP (Novo) feed was used during the entire cycle, distributed manually by using of boat. During the first month after stocking, feeding rates were based on estimated survival and feeding tables and distributed four times per day. After 30th DOC, daily rations were adjusted using feed trays and increased to five times per day there after.

The use of feed trays is extremely important in the control of feeding. They provide information regarding the feed consumption, the health and survival of the shrimp and also the condition of the pond bottom. It is also necessary to use a lift net to find out if the amount of feed is given properly. If the shrimp not consumed all the feed within the given time, we have to reduce the feed to prevent over feeding. Left over feed can cause the pond bottom to decay and water becomes deteriorated easily, the shrimp will be weak and stressed. They will also avoid feeding and easily get sick and eventually die.

Sampling: Cast net was used to measure the growth rate of shrimps. The first sampling was taken after 40th days of culture and number of individuals and the average body weights were recorded in each sampling. Five hauls were made in each pond. Healthiness, survival rate, Average Body weight (ABW) and Average daily growth (ADG) of the animals was estimated. Sampling was regularly performed every ten days until harvest.

Harvesting: A bag net was fitted on outlet canal with a 20 numbers mesh of width 1m and length of 4 m. The water level in the ponds was reduced from 1m to 60 cm and then out let was opened and shrimp were caught and collected.

RESULTS

The water quality parameters in the culture ponds are displayed in the Table 4. The salinity was recorded maximum 26 ppt and minimum 10 ppt for both high and low density ponds. The average pH was between 7.7 to 8.4. The dissolved oxygen was ranged between 3.3 to 4.2 ppm.

Due to nursery method (using Cyclop-eeze feed) the survival was good in both low and high density ponds.

Table4: Water quality parameters in the culture ponds.

Parameter	G1,G2,G3,G4,G5&G6 Low density Ponds ($8/m^2$)	H1 H2,H3,H4,H5&H6 High density Ponds ($15/m^2$)
Salinity	10-26	10-26
pH	7.7-8.2	7.8-8.4
Dissolved oxygen (ppm)	3.8-4.2	3.3-4.0
Temperature (°C)	25-31	25-31
Transparency (cm)	30-40	25-45

The survival rate in low density ponds was 97% and high density ponds was 92%. Maximum growth was observed in the low density ponds during each sampling interval and by the end of the experiment. Average weight gained for the shrimps that were stocked with low density ponds was approximately 25% greater than that of the high density ponds (Table 5).

Economics: Maximum net profit was obtained from low density ponds (Rs.1, 92,480) and minimum was in high density ponds (Rs.68, 416) (Table 6).

DISCUSSION

There has been a considerable increase in the culture of brackish water shrimp due to its taste, market demand both national and international markets. In order to prevent many problems due to shrimp culture, sustainable shrimp farming is the need of the hour. Ideal pond size for shrimp culture was 1 or less than 1 ha (Ramanathan *et al.*, 2005). In the present investigation also 10 ponds were used for shrimp culture and each pond size was 0.5 ha. Even though shrimps are bottom dwelling organisms, the depth and volume of water in a pond has certain physical and biological consequences. The volumes of water behave like a buffer, which prevents weather fluctuations from influencing the environment in which shrimp lives. The ideal water depth is between 0.8 to 1.5 m depending upon the stage of culture. It is recommended that a minimum depth of 1m is maintained at operational level. In the present study 100 cm water level was maintained in all ponds throughout the culture period.

When a pond is ready for operation, the optimum stocking density of seeds in a pond determined in accordance with the production capacity of the pond and the culture system, which included the soil and water quality, food availability and seasonal variations, target production and farmers experience (Ramanathan *et al.*, 2000). The stocking density between 10–20PLs/m^2 is ideal for successful shrimp farms (Ramanathan *et al.*, 2005). In the present study the seeds were stocked at the stocking density of 8/ m^2 in five ponds and also 15/ m^2 in the remaining five ponds.

Table5: Average body weight of *P.monodon* in low and high density ponds.

PONDS	Days of culture (DOC) 40	50	60	70	80	90	100	111	121	130	141
	Average body weight (ABW) (g)										
G1,G2,G3,G4,G5&G6 (8 / m^2)	8	11.5	14.81	18.6	22	25.73	29.2	33.1	36.5	#	#
H1,H2,H3,H4,H5&H6 (15/ m^2)	51	7	9.2	11.4	13.3	15.6	18.2	20.3	22.5	25	27.2

Table 6: Average harvest details and economics of *P. monodon* cultured in hig and low density ponds.

Particulars	Low and high density ponds (8/m^2)	(15/m^2)
Pond area (m^2)	5,000	5,000
Stoking density/m^2	8	15
Initial stock	40,000	75,000
Average daily growth	0.3	0.2
Culture period (Days)	121	142
Total Production (Kg)	1,416	1,877
Production (Ton/ha)	2,832	3,754
Size of harvest (g)	36.5	27.2
Survival rate (%)	97	92
Feed intake	1,840	3,190
FCR	1.3	1.7
Income (Rs)	3,96,480	3,90,416
Total seed cost (Rs)	12,000	22,500
Total feed cost (Rs)	92,000	1,59,500
Other expenses (Pond preparation, water culture, probiotics & electrical charges etc.)	1,00,000	1,40,000
Net Profit (Rs)	1,92,480	68, 416

The maintenance of good water quality is essential for optimum growth and survival of shrimps. The levels of physical, chemical and biological parameters control the quality of pond waters. The level of metabolites in pond water can have an adverse effect on the growth. Good water quality is characterized by adequate oxygen and limited level of metabolites. Excess feed, faecal matter and metabolites will exert tremendous influence on the water quality of the shrimp ponds. Hence critical water quality parameters are to be monitored carefully as adverse conditions may be disastrous effect on the growing shrimps (Ramanathan *et al.,* 2005).

Salinity is important parameters to control growth and survival of shrimps. Even though *P. monodon* is euryhaline animals it is comfortable when exposed to optimum salinity. At high salinity the shrimps will grow slow but they are healthy and resistance to diseases. If the salinity is low the shell will be weak and prone to diseases. The salinity of the present study was maintained 10-26 ppt in all ponds (Table 4). Muthu (1980), Karthikeyan (1994) and Soundarapandian & Gunalan (2008) recommended a salinity range of 10-35 ppt was ideal for *P. monodon* culture. While Chanratchakool *et al.* (1994) and Rajalakshmi (1980) maintained the salinity of 10-30 ppt and 15-20 ppt respectively. Chen (1980) opined that salinity ranges of 15-20 ppt are optimal for culture of *P.monodon*. There are few reports (Shivappa and Hambry, 1997; Ramakrishnareddy, 2000; Collins & Russel, 2003), which stated that *P. monodon* adapted quite well in freshwater conditions also because of its wide range of salinity tolerance.

Dissolved oxygen plays an important role on growth and production through its direct effect on feed consumption and maturation. Oxygen affects the solubility and availability of many nutrients. Low levels of dissolved oxygen can cause damages in oxidation state of substances from the oxidized to the reduced form. Lack of dissolved oxygen is directly harmful to shrimps and causes a substantial increase in the level of toxic metabolites. Low-level of oxygen tension hampers metabolic performances in shrimp and can reduce growth and moulting and cause mortality (Gilles, 2001). The dissolved oxygen in all the culture ponds in the present study was ranging between 3.3 to 4.2 ppm (Table, 4). pH is one of the vital environmental characteristics, which decides the survival and growth of shrimps under culture; it also affects the metabolism and other physiological process of shrimps. The optimum range of pH 6.8 to 8.7 should be maintained for maximum growth and production (Ramanathan *et al.*, 2005). In the present study pH was ranging between 7.7 to 8.4 for the culture ponds as well as water source. Saha *et al.* (1999) noticed the pH of 8.11 to 8.67 in low saline ponds. Ramakrishnareddy (2000) was recommended pH of 7.5 to 8.5 for *P.monodon* culture. The pH of pond water is influenced by many factors, including pH of source waters and acidity of bottom soil and shrimp culture inputs and biological activity. The most common cause of low pH in water is acidic bottom soil, liming can be used to reduce soil acidity. In most common cause of high pH is high rate of photosynthesis by dense phytoplankton blooms. When pH is high water exchange will be better choice (Boyd, 2001).

Water temperature is probably the most important environmental variables in shrimp cultures, because it directly affects metabolism, oxygen consumption, growth, moulting and survival. In general, a sudden change of temperature affects the shrimp immune system. The optimum range of temperature for the black tiger shrimp is between 28 to 30ºC (Ramanathan *et al.*, 2005). The temperature in the present study was 25 to 31 ºC and the low temperature 25 ºC was observed due to cloudy weather (Table 4). The optimum range of temperature of *P. monodon* was between 26 to 33 ºC and temperature range of 28 to 33 ºC supports normal growth (MPEDA, 2006) as observed in the present study.

The transparency is mainly depends on the presence of phytoplankton. The secchi disc reading should be between 30-40 cm (MPEDA, 2006). The optimum range of secchi disc reading is between 30 to 60 cm to the juvenile stage and between 25 to 40 cm to the sub adult and final stage. The transparency of the present study is 25 to 45 cm (Table 4). Ramakrishnareddy (2000) also observed similar transparencies (35-50 cm) for his study. The reading less than 30 cm mean that the phytoplankton density is high. If it is more than 40 cm indicates, low population of phytoplankton. For the growth of phytoplankton adequate quality of sunlight is needed. Due to low intensity of light during the culture period, the plankton bloom was less. Hence, the transparency was more.

Feed is one of the essential inputs in shrimp production and increase profits. Feed management is highly subjective, as feed consumption cannot be directly observed. In the present study CP feeds was used for all ponds and the amount was followed as per feed chat. Maximum amount of feed was given to high density ponds. The FCR for low density ponds were 1.3 and high density ponds were 1.7. Average Indian cultured food conversion ratios were varying between 1.5 to 1.75 (Paul Raj, 1998). Cheekati (1995) observed the food conversion ratios were varying from 1.50 to 1.55 when microencapsulated diets are used. Saha *et al.* (1999) observed that the food conversion ratios of 1.31 to 1.58 in low saline ponds and 1.35 and 1.68 in high saline ponds. Ramakrishnareddy (2000) observed FCR of 1.58 for his study.

Periodic sampling is very vital for successful shrimp culture. It is recommended to do weekly or fortnightly sampling to check the health condition as well as to estimate the growth of shrimps. Sampling also helps to know the average weight and this would help in estimating the total biomass in the pond for better-feed management. Growth of shrimps depends mainly on pond water quality and effective management of feeding. Cyclop-eeze was used as a feed in the present study played a major role for the better growth of shrimps. It is observed that growth rate of shrimps in the present study is rapidly increasing after DOC 40 in all ponds due to accurate feed manipulation by sampling.

In the present study higher survival (97%) was recorded in the low density ponds and lower survival (92%) was achieved in the high density ponds. The survival ranging between 92–97% and the average survival for all the ponds were 94.5% (Table 6). Krantz & Norris (1975) stated that survival rates of 60 to 80% are to be expected for *P. monodon* under suitable rearing conditions. It was achieved because the stocking density of 5, 000 to 8,000 PLs/ha. In the present study also totally 40,000 PLs for low density ponds and 75,000 pls were stocked for high density ponds. Ramakrishnareddy (2000) got 76% survival and average body weight of 35.22 g. According to him 70 –80% survival is possible if the idle conditions are maintained for *P. monodon*. In the present study the average body weight of the shrimps were calculated for low and high density ponds were 36.5 and 27.2 g respectively.

The size of culture shrimps, market price and moulting percentage of shrimps plays a vital role in fixing the harvesting. So timely harvest is very essential in aquaculture system. The average production from low density (G1, G2, G3, G4 and G5) ponds were 2,832 kg and the average body weight is calculated as 36.5 g, but in the high density ponds (H1, H2, H3, H4andH5) it was 3,754kg and average body weight was 27.2 g only. So it is confirmed that $8/m^2$ is an ideal stocking density for the culture of *P. monodon* as evidenced from the high net profit Rs 1, 92,480. To get this profit, proper nursery stocking, providing of Cyclop-eeze feed, water quality management and feed management is essential.

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