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South Indian Technology of Nursery Farming for Better Survival and Production of *Macrobrachium rosenbergii* (De Man)

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Abstract: In the present study, the nursery culture was practiced in 4 different farms (A, B, C and D). The salinity was ranging between 0-4 ppt and alkaline pH (7.0-8.3) was maintained by adding lime in all 4 ponds. The temperature fluctuations were not beyond the optimum (26-32°C) and the dissolved oxygen level was ranging between 3.5 to 6.5 ppm throughout the culture period in all four farms. Optimum transparency (31-42 cm) was maintained throughout study period. The food conversion ratio of the present study ranges from 1:1.23 to 1:1.47. The survival rates of farms A, B, C and D were 78, 83, 80.32 and 81%, respectively. The maximum average body weight of 22.0 g in male population and 19.70 g in female population was reported in farm A, where the crop pattern is 5 seeds/m^2/110 days. Whereas in farms B, C and D the crop pattern was 11 seeds/m^2/70 days, 15 seeds/m^2/70 days and 20 seeds/m^2/70 days, respectively. The average body weight of females in the farms B, C and D are 4.16, 5.30 and 3.75, respectively. In farm A, all the female's population with the average body weight of 19.70 g was sold out in good price. The total (482 kg) production also high in farm A where as B, C and D farms it was 85, 277.38 and 280.62 kg, respectively. Extension of nursery culture up to 110 days, proper water quality and feeding management in nurseries and low stocking density are reported to get the maximum growth and total production in farm A. This is highly profitable business those who are maintaining their own ponds. The nursery culture period in farms B, C and D was 70 days. The male production in farms B, C and D were 7,400, 20,060 and 24,652 numbers, respectively. So, the culture period of 70 days and semi-intensive type of culture is found more profitable for male scampi seed selling farmers.

Key words: *Macrobrachium rosenbergii*, juveniles, seeds, farms, food conversion ratio, transparency

INTRODUCTION

The freshwater prawns coming under genus *Macrobrachium* are commercially important. There are about 150 species of *Macrobrachium* identified from various parts of the world, of which about 25 species are found in India. Of these, *M. rosenbergii* and *M. malcolmsonii* are suitable for farming in India. The giant prawn, *M. rosenbergii* is commonly known as scampi of immense popularity in commercial aquaculture (Reddy, 1996). The annual scampi culture production of the country has registered a significant increase from 2,127 Metric Tones in 1994-95 to 7,500 Metric Tones in 2000-01 and 10,300 Metric Tones in 2002-03 (MPEDA, 2003). In order to achieve higher survival and to reduce the grow out period an intermediate nursery phase is essential. The males are usually bigger and grow fast during culture. The monosex farming of males or only male culture is getting wider

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attention among the scampi farmers for earning more profit. Some entrepreneurs in India especially in Tamil Nadu selling the nursery reared male scampi juveniles around the weight of 3-5 g to the farmers (MPEDA, 2003). So, nursery rearing not only fulfills the seed requirements of individual farmers and also creates an opportunity to sell male population for good price. So, in the present study a trial was attempted for the nursery rearing of *M. rosenbergii* seeds in four different ponds.

MATERIALS AND METHODS

The present study has been conducted in 4 farms. The names of the farms, total area and area of nursery culture are presented in Table 1.

Pond Preparation

Initially all the farms of the present study was allowed to dry for 30 days to eradicate unwanted species of fish, insects, vegetation etc. and to helps to improve the fertility of the soil by mineralization of nutrients in the pond sediment. Than the pond bottom was ploughed to remove the obnoxious gases, oxygenate the bottom soil, discoloration 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 neutralizes the acid soil conditions and increases the availability of nutrients.

Shelters

To avoid cannibalism during molting, coconut leaves were placed randomly in all nursery ponds as a shelter.

Water Culture

The initial water levels in the farms (A, B, C and D) were maintained at 60 cm level. The organic fertilizers such as cow dung were applied (only the extract) to the ponds. After 4 days the water color turned to light green. Then water level was raised to 100 cm of the ponds and added super phosphate and urea in required amount to improve the primary production. Fertilization enhanced the optimal algal bloom in the ponds. Transparency in the farms ranged from 33 to 37 cm.

Seed Transport

M. rosenbergii (PL) seeds were purchased from nearby hatchery, Kanathur. The seeds were strong, healthy with bright coloration. They were active and uniform size with a translucent body and tend to swim against water when swirled. The seeds were transported in oxygenated double-layered polythene bags with crushed ice pieces between inner and outer covers of the bag and packed in Styrofoam boxes.

Acclimatization of Seeds Before Stocking

First the bags with seeds were allowed to float on the farm water for one hour to equalize the temperature. Subsequently the bags were opened and the farm water was sprinkled into the bags in order to acclimatize the post larvae to farm environmental conditions.

Table 1: Details of nursery farm

Name of the farm	Location	Total area (H)	Nursery area (A)	Water source
M. Govindaraj Aqua farm (A)	Thirumanur of Perambalur Dt.	3.00	1.50	River Cauvery
Vaithilingam Aqua farm (B)	Mandalakottai of Thanjavur Dt.	4.50	0.50	River Cauvery
M. Sivakumar Aqua farm (C)	Pulavarayankudikadu of Thiruvarur Dt.	4.50	1.00	River Cauvery
N. Srinivasan Aqua farm (D)	Kattur Thiruvallur Dt.	2.80	1.00	River Kattaru

Stocking

The stocking density of the seeds was 5, 11, 15 and 20 m^{-2} in the farms A, B, C and D, respectively.

Water Quality Management

The water level was measured by using a standard scale with cm marking. The water salinity was measured by using a hand refractrometer and pH by using pH pen. Water temperature was measured with the help of a standard centigrade thermometer. The dissolved oxygen was estimated by dissolved oxygen meter. Transparency was quantified in terms of the light penetration using a secchi disc. Water was exchanged according to the color of the water. If the water becomes dark green in color immediately water is exchanged.

Feed Management

In all the 4 farms, classic scampi commercial feed was used. It contains 30-33% crude protein, 3 to 3.5 fat, 4-5% fiber and 11% moisture. During the first month of culture, feeding was done on the peripheral regions and from second month onwards central broadcasting was followed to feed all around the ponds. First fifteen days of culture, starter 1 feed was given to all 4 farms. During 15-30 days, 25% starter 1 and 75% starter 2 feed was provided. During 30 to 60 days, starter 2 feed was provided to the prawns in all the 4 farms. During 60 to 70 days, 50% of starter 2 and 50% of grower feed was provided in all the farms (B, C and D). In farm A, during the days of culture of 60 to 80, starter 2, 25% and grower 75% was mixed thoroughly and provided to the prawns and grower feed was offered after the days of culture of 80 to 110. Feeding initially started with 10% of the body weight and slightly reduced to 10 to 3% at regular weekly intervals, after the ABW monitoring by random sampling. Feeding was manipulated for every week based on the average body weight of the prawns. Feeding frequency increased with increasing size of organisms and days of culture.

Monitoring of Growth

Sampling of prawns was carried out by cast net. Cast net operation was done in early morning when prawns are well distributed in the ponds as well as to avoid sunlight. The sampling was done once in every week intervals.

Harvesting

The water level in the ponds was reduced from 1.20 to 0.5 m and then a seine net was used for harvesting. It is found that seining is an effective method for catching prawns for segregation.

RESULTS

The water level of 120 cm was maintained throughout the culture in all 4 farms. The salinity of the farms A and B was 0 ppt where as it was 2 and 4 ppt in the farms C and D, respectively. In farm A, pH ranged from 7.0 to 8.2. Maximum pH 8.2 was found during days of culture 31 and minimum pH 7.0 was observed at days of culture 103. In farm B, pH ranged from 7.2 to 7.9. The maximum pH 7.9 was recorded during days of culture 23 and minimum pH 7.2 was during days of culture 55. In farm C, pH ranged from 7.1 to 8.1. Maximum pH 8.1 was recorded during days of culture 18 and minimum pH 7.1 was recorded during days of culture 52. In farm D, pH ranged from 7.3 to 8.3. The maximum pH 8.3 was recorded during days of culture 12 and the minimum pH 7.3 was recorded during days of culture 40 (Table 2).

In farm A, temperature ranged between 27 to 31°C. The maximum temperature 31°C was observed during Days Of Culture 76 and the minimum temperature 27°C was recorded during

Table 2: Water quality parameters during the culture period

Parameters	Pond A	Pond B	Pond C	Pond D
Salinity (ppt)	0	0	2	4
pH	7.0-8.2	7.2-7.9	7.1-8.1	7.3-8.3
Temperature (°C)	27-31	27-32	26-32	26-31
Dissolved oxygen (ppm)	4.5-6.5	4.0-6.5	3.5-6.3	3.6-5.8
Transparency (cm)	32-41	33-42	31-39	32-38

days of culture 34. In farm B, temperature ranged between 27 to 32°C. The maximum temperature 32°C was observed during days of culture 66 and the minimum temperature 27°C was at days of culture 53. In farm C, temperature ranged between 26 to 32°C. The maximum temperature 32°C was observed during Days Of Culture 48 and the minimum temperature 26°C was recorded during days of culture 21. In farm D, temperature ranged between 26 to 31°C. The maximum temperature 31°C was observed during days of culture 62 and the minimum temperature 27°C was recorded during days of culture 33.

In farm A, dissolved oxygen concentration ranged from 4.5 to 6.5 ppm. The maximum dissolved oxygen level of 6.5 ppm was recorded during days of culture 32 and the minimum dissolved oxygen 4.5 ppm was found when the days of culture was 65. In farm B, dissolved oxygen concentration ranged from 4.0 to 6.5 ppm. The maximum dissolved oxygen level of 6.5 ppm was recorded during days of culture 23 and the minimum dissolved oxygen 4.0 ppm was observed when the days of culture was 57. In farm C, dissolved oxygen concentration ranged from 3.5 to 6.3 ppm. The maximum dissolved oxygen level of 6.3 ppm was recorded during days of culture 31 and the minimum dissolved oxygen 3.5 ppm was found when the days of culture was 65. In farm D, dissolved oxygen concentration ranged from 3.6 to 5.8 ppm. The maximum dissolved oxygen level of 5.8 ppm was recorded during days of culture 20 and the minimum dissolved oxygen 3.6 ppm was found when the days of culture was 52 (Table 2).

In farm A, transparency ranged from 32 to 41 cm. The maximum transparency 41 cm turned out during days of culture 28, the minimum transparency of 32 cm was recorded when the days of culture was 43. In farm B, transparency ranged farm 33 to 42 cm. The maximum transparency 42 cm was during days of culture 38, the minimum transparency of 33 cm was recorded when the days of culture was 54. In farm C, transparency ranged farm 31 to 39 cm. The maximum transparency 39 cm turned during days of culture 34, the minimum transparency of 31 cm was recorded when the days of culture was 50. In farm D, transparency ranged farm 32 to 38 cm. The maximum transparency 38 cm turned during days of culture 41, the minimum transparency of 32 cm was recorded when the days of culture was 62 (Table 2).

Harvesting

Harvest was carried out in farm A at days of culture 110. Where as in the farms B, C and D it was at days of culture 70. In farm A, 201 kg males with the ABW of 22 g and 281 kg females with the Avarage Body Weight (ABW) of 19.70 g were harvested. The ratio of the male and female was 39 and 61%, respectively. The survival rate at the time of harvest was 78%. In farm B, 39 kg of males with the ABW of 5.27 g and 46 kg of females with the ABW of 4.16 g was harvested. The ratio of male and female during harvest was 40 and 60%, respectively. The survival rate at the time of harvest was 83%. In farm C, 128.38 kg of males with the ABW of 6.4 g and 149 kg of females with the ABW of 5.30 g was harvested. The male and female ratio was 42 and 58%, respectively. The survival rate at the time of harvest was 80.32%. In farm D, 129.79 kg of males with the ABW of 4.90 and 150.83 kg females with the ABW of 3.75 was achieved. The formation of male and female was 38 and 62%, respectively. The survival rate at the time of harvest was 81%. The maximum ABW of males 22 g and females 19.70 g was reported in farm A, where the crop pattern of 5 seeds/m^2/110 days. The minimum average body weight of males 4.90 g and females 3.75 g was reported in farm D, where the

Table 3: Harvest details of *M. rosenbergii* seeds reared in nursery farms

Particulars	Farm A	Farm B	Farm C	Farm D
Pond area (m^2)	6000	2000	4000	4000
Stocking density m^{-2}	5	11	15	20
Types of culture	Extensive	Semi-intensive	-do-	-do-
Feed intake (kg)	621.50	125.17	341.24	389.36
FCR	1:1.29	1:1.47	1:1.23	1:1.43
Culture period (Days)	110.00	70.00	70.00	70.00
Average body weight of males (g)	22.00	5.27	6.40	4.90
Average body weight of females (g)	19.70	4.16	5.30	3.75
Total male production (kg)	201.00	39.00	128.38	129.79
Total female production (kg)	281.00	46.00	149.00	150.83
Total production (kg)	482.00	85.00	277.38	280.62
Formation of males (%)	39.00	40.00	42.00	38.00
Formation of females (%)	61.00	60.00	58.00	62.00
Survival rate (%)	78.00	83.00	80.32	81.00

crop pattern of 20 seeds/m^2/70 days. There are 3 types of males were recorded from the farm A once they reached the size of 10 g. The total male population 70% contributed by fast growing Orange Clawed (OC) males and remaining 30% shared by 15% Blue Claw (BC) males and 15% small males (Table 3).

DISCUSSION

The aggressive and cannibalistic nature of *M. rosenbergii* under crowded conditions is a major problem encountered while attempting to rear the post larvae at high population densities. Often, mortality and low survival of juveniles in the early phase of rearing is common which affect yield and profitability in freshwater prawn culture. Parameswaran *et al*. (1990) recommended nursery rearing before stocking in grow out system such as ponds tanks and reservoirs. This has necessitated the development of indoor and outdoor nursery systems, which will reduce the mortality of post larvae resulting from differential growth and cannibalism (Sebestian *et al*., 1992). After initial stocking, the post larvae undergo 'no growth' period, which is called 'log period' may extend up to about 30-40 days after which exponential growth resumes. Spending this period in higher culture pond results in unnecessary expenditure. Apart from higher stocking, the nursery phase is beneficial for other reasons also. The weak and unhealthy seed is eliminated at the nursery stage itself, hence the survival of seed transferred to culture pond increases. Bigger and robust seed can be selected and counted before stocking and also the culture period may be shortened by about 1 month (Ramakrishna and Prasad Rao, 2000).

Water quality is a major component influencing much in aquaculture production. The maintenance of water quality will not only ensure the healthy environment and also will improve the survival rate, better growth pattern and ultimately ensures good production. The standardization of pH, optimal stocking, optimal feeding and regular monitoring of water quality will help to prevent the pond water quality from more fluctuations. The variations of dissolved oxygen; temperature, salinity and productivity rates are the key factors in the culture system, which plays an important role in keeping the prawn in good condition (Ang, 1989). The post larvae of the scampi are euryhaline, but it can grow well in the salinity range of 0-5 ppt (Kumar *et al*., 2004). The salinity of the present study is also ranging from o to 4 ppt (Table 2). The pH values in farms A, B, C and D found always on the alkaline side. However, pH of the farm D was higher due to calcium carbonate deposition in the soil of that area. The pH values in all the farms were maintained at the alkaline side by adding lime to the pond water. Since the period of nursery rearing was only 70-110 days there was no serious fluctuations in temperature was observed. Success in aquaculture production is mainly depends on primary

productivity or phytoplankton bloom. Post larvae are especially sensitive to the effect of algal blooms (New, 2002). The optimum transparency level of 31 to 42 cm was maintained in all the 4 farms throughout the nursery phase.

The profitability of prawn farming is largely depends on selection and use of feed, which constitutes around 35-65% of total operational cost. The freshwater prawn, *M. rosenbergii*, has a lower nutritional requirement than tiger shrimp. During the nursery phase, most of the farmers use feeds made by commercial feed companies with the protein range of 28-32% (Nagarajan and Chandrasekar, 2002). In the present study also commercial feed was used for all 4 farms. The protein content of the commercial feed was 30-33% as recommended by many others. Feeding once or twice per day is sufficient for better production (New, 2002). Feed conversion ratios in well-managed culture system run 1:1.30 (Nagarajan and Chandrasekar, 2002). In the present study also the Food Conversion Ratio ranges from 1:1.23 to 1:1.47 (Table 3). The salinity range of 0-4 ppt in the present study was not affect the food conversion ratio and survival rate of scampi.

Periodic sampling is very vital for successful scampi culture. It is recommended to do weekly or fortnightly sampling to check the health condition as well as to estimate the growth of the prawns. Sampling also helps to know the male and female ratio; average weight and this would help in estimating the total biomass in the pond for better feed management. Growth of the prawns depends mainly on pond water quality and effective management of feeding. It is observed that the growth rate of prawns in the present study is rapidly increasing after 30 days of culture in all the farms due to accurate feed manipulation by sampling.

The growth rate falls with increasing stocking density, irrespective of the size at stocking (Subramanyam, 1998). Juvenile fresh water prawns often begin to exhibit heterogeneous growth during the nursery period. This disparity in size continues indefinitely and can subsequently impact growth, uniformity; yields and food conversion during grow out period (Lutz, 2002). In the present study also coincides with the above findings that in all 4 farms the growth rate is irrespective of the stocking density.

Survival rate of *M. rosenbergii* in the nursery have been found to be density dependent. The survival rates of the ponds A B, C and D are 78, 83, 80.32 and 81% at the stocking density of 5, 11, 15 and 20 m^{-2}. In pond A the survival was little bit low when compared to other ponds. This is attributed to longer rearing periods (110 days) where as in other ponds the rearing period is less (70 days). However, increases rearing period are increases total production in pond A than other ponds.

The survival rates of prawns ranged from 82.5 to 85.6% for the lower stocking density of 40 m^{-2} and from 80.5 to 83.1% for a slightly higher stocking density of 50 m^{-2}. In both the stocking densities the survival rate was above 80%. The results suggest that the juvenile could withstand considerable crowding and survival rate were not exclusively density dependent. On the contrary, Santifer *et al*. (1983) reported survival and growth to be density dependent. Parameswaran *et al*. (1990) stated that there was no significant difference in growth and survival when stocking densities were maintained at 200, 300 and 400 post larvae m^{-2}. Ang (1989) achieved a survival rate of 60 to 80% at stocking densities of 450-1,000 post larvae m^{-2}, at about 4 weeks of rearing. Prasad (1993) reported a survival of 71% for post larvae reared at stocking density of 100 m^{-2} and the mean size at the time of harvest obtained was 1.4 g at 61 days. In the present study also the average body weight of the prawns in the farms A, B, C and D are 1.4, 0.82, 1.5 and 0.8 g, respectively at days of culture 60 (Table 3). Marx *et al*. (2000) were achieved 80% survival after 70 days rearing for the stocking density of 40 post larvae and 50-post larvae m^{-2}. Initially the post larvae are stocked at 500 to 1,000 m^{-2} for the rearing period of 10 to 15 days. If the post larvae reared beyond 25-30 days, the stocking rate should be reduced to 200 to 300 m^{-2} to get better survival (Reddy, 1996). Prawn larvae

are usually stocked at the stocking density of 20-25 m^{-2} and reared for a period of 40-45 days (Nagaraj and Chandrasekar, 2002). The recommended stocking density of the seeds in nursery ponds are 25pcs m^{-2} without aerators, which can be increased up to 50 PCS m^{-2} if provided with 4 aerators ha^{-1} and the rearing period was 40-45 days (MPEDA, 2003).

The size of culture prawns, market price and molting percentage of prawns plays vital role in fixing the harvesting. So timely harvesting is very essential in aquaculture system. In the nursery phase of fresh water prawn culture, harvesting is mainly denotes the segregation of sizes or sexes from nursery ponds to culture ponds. In farm A the prawns were harvested after 110 days of culture. In farms B, C and D, the prawns were harvested well advance at about 70 days of culture period.

The price of female scampi is just 50% of market price of males due to egg formation. It is observed that the formation of eggs at Average Body Weigh of 19.70 g among females was below 5% and maximum production of 281 kg. So, it is best to sell the females before egg formation to get reasonable revenue. In the present study the growth rate of prawns increased rapidly after they attain average body weight of 5 g and above in farm A. The total (482 kg) production also high in farm A where as farms B, C and D it is 85, 277.38 and 280.62 kg, respectively. Extension of nursery culture up to 110 days, proper water quality and feeding management in nurseries and low stocking density are reported to get the maximum growth rate and total production in the farm A. This is highly profitable business those who are maintaining their own farms.

The recent development of fresh water prawn industry is monosex farming, especially male culture. So the demand of the male seeds is more among the farmers in Tamil Nadu. Seasonal water tanks holding water for 5-6 months is also suitable for monosex farming of males. The duration of the nursery culture in farms B, C and D was 70 days. The production of males from the farms B, C and D are 7,400, 20,060 and 24,652 nos, respectively. So, the culture period of 70 days and semi-intensive type of culture is found more profitable for male scampi seed selling farmers, because they need only 3 to 5 g sized males.

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