Influence of stocking density on growth, production and survival of *Macrobrachium rosenbergii* (de Man) in a monoculture grow-out pond

N. NAGARATHINAM, J. STEPHEN SAMPATH KUMAR* AND V. SUNDARARAJ
Fisheries College and Research Institute, Tamil Nadu Veterinary and Animal Sciences University, Tuticorin-628 008, India

ABSTRACT

Growth and production characteristics of *Macrobrachium rosenbergii* stocked at two densities were examined. Prawn juveniles (0.78±0.54 g) were reared for 180 days in 0.0014 ha tanks at two stocking densities (5/m\(^2\) and 10/m\(^2\)) individually. The culture tanks were manured with cowdung and inorganic fertilizers and a supplementary feed of 22% crude protein was given to the prawns. The results indicated that at low stocking density (5/m\(^2\)) the growth and survival were higher. Prawns attained a final mean body weight of 31.32±21.5 g and 28.38±14.23 g in low and higher stocking densities, respectively. The estimated productions were 984.34 and 1,662.26 kg/ha per crop, respectively for two stocking densities. Higher mean growth rate, specific growth rate and low FCR were witnessed only in the low stocking density. The relationship between growth and days of culture is significant (P<0.05) in the two stocking densities but, the difference between growth rates of the prawn at the two densities tried is non-significant (P>0.05). Advantages of low stocking are witnessed with reference to individual body weight at the harvest.

Total global production of *M. rosenbergii* through aquaculture in 1996 has been reported as 55,115 t and the contribution of India was only 178 t (FAO, 1998). However, the potential for freshwater prawn production in India has been estimated to be 3,000 t per year (Sundararaj and Stephen, 1998).

Several factors are reported to be affecting the production, especially growth and survival in freshwater prawn farming worldwide (New, 1995). The stocking rate is found to be a major factor affecting the individual growth of

* Author for correspondence.
prawns (Karplus et al., 1986), which was observed to depend on the market size desired and management of the pond (New, 1995). The stocking rate adopted for freshwater prawn farming varied from 1 to 10 per m² in different parts of the world. In India, the stocking density of freshwater prawn is reported to be between 2 and 5 per m² (Stephen, 1997). Higher net production was reported when the stocking density was increased (Wohlfarth et al., 1985). Therefore, an investigation was done to find out the influence of higher stocking density on the general production parameters of *M. rosenbergii*.

**Materials and methods**

Hatchery produced postlarvae of *M. rosenbergii* (0.0058 g mbw) were reared in nursery tanks for a period of 60 days and the juveniles were used for the present study. Experiments were conducted in 0.0014 ha cement ponds of depth 1.3 m and provided with broken tiles and PVC pipes (80 mm dia; 300 mm length) at the bottom to serve as shelter. Water depth was maintained at 95±5 cm by drawing water from the nearby small reservoir. The juveniles (45.5±8.9 mm and 0.78±0.54 g) were stocked at 5/m² and 10/m² densities in duplicate (M₁ and M₂ experiments).

Stocking was done after an initial fertilization (one week) of tank water with cow dung (2,000 kg/ha), urea (34 kg/ha) and super phosphate (40 kg/ha). The initial fertilization was done with 1/6 of the prescribed doses and the rest were kept for phased fertilization. Transparency of the tank water was taken as an indicator for the strength of fertilization in the culture tank. Pond water was partially (20-30%) exchanged fortnightly during the culture period. Phased fertilization depending on the natural food production was done as suggested by Shirgur et al. (1991) and the production of natural food was maintained.

Water quality parameters such as dissolved oxygen, pH and temperature were monitored daily, while hardness, ammonia-N and nitrite-N were recorded once a week following the standard procedures. During the grow-out period, a sample of 20 prawns was collected and bio-parameters recorded every month. The sampling was done by draining out the pond water upto 20% level. Mean body length and weight were calculated for a random sample of prawns and the total number of prawns was ascertained to have accurate feeding rate.

Pelleted feed (22% crude protein) was given to the prawns as supplementary feed following the feeding chart of D’Abramo and Sheen (1991). Harvesting was done after 180 days by completely draining the tank water. Based on the observed growth and production, the parameters like growth rate, specific growth rate and food conversion ratio were estimated.

Mean body weights were regressed against time (days post-stocking) and tested for significance. The general linear test was used to test the equality of regression lines for the two treatments (Neter and Wasserman, 1974). Differences in regression lines and their slopes were compared using student’s t-test (Snedecor and Cochran, 1980).

**Results**

The growth parameters recorded during the culture period are shown in Table 1. In M₁ experiment (5/m²), the
final mean length and weight were 130.8±2.78 mm and 31.32±21.5 g, respectively. The average growth rate was 0.17 g/day. The estimated specific growth rate was 2.04% and food conversion ratio was 3.8. The gross production of *M. rosenbergii* at a stocking density of 5/m² was calculated to be 984.34 kg/ha per crop with a final survival of 62.86%.

In M₂ experiment (10/m² density), the final mean length and weight were 129.5±24.7 mm and 28.38±14.23 g, respectively. The average growth rate was 0.156 g/day. The specific growth rate was 2.86% and FCR was 4.9. The estimated gross production of *M. rosenbergii* in M₂ experiment was found to be 1,662.26 kg/ha/crop. The final survival was 58.57%.

The growth patterns of prawns in M₁ and M₂ are depicted in Fig. 1. Monthly net growth rates of *M. rosenbergii* at two densities are presented in Fig. 2. Percentage occurrence of prawns based on their body weight at harvest is shown in Fig. 4. The overall mean values of water quality parameters of M₁ and M₂ experiments recorded during the culture period are presented in Table 2.

### Table 1. Production and growth parameters of *M. rosenbergii* reared in two different stocking densities

<table>
<thead>
<tr>
<th>Expt.</th>
<th>Body weight (g) ± SD</th>
<th>Survival (%)</th>
<th>Gross production (kg/ha/crop)</th>
<th>Mean growth rate (g/day)</th>
<th>Specific growth rate (%/w per day)</th>
<th>FCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>M₁</td>
<td>5</td>
<td>0.78 ±0.54</td>
<td>31.32 ±21.54</td>
<td>62.86</td>
<td>984.34</td>
<td>0.17</td>
</tr>
<tr>
<td>M₂</td>
<td>10</td>
<td>0.78 ±0.54</td>
<td>28.38 ±14.23</td>
<td>58.57</td>
<td>1,662.26</td>
<td>0.156</td>
</tr>
</tbody>
</table>

### Table 2. Mean values of water quality parameters in the experimental tanks

<table>
<thead>
<tr>
<th>Parameters</th>
<th>M₁ (5 per m²)</th>
<th>M₂ (10 per m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature (°C)</td>
<td>29.44 ±2.31</td>
<td>32.47 ±2.3</td>
</tr>
<tr>
<td>PH</td>
<td>8.92 ± 0.59</td>
<td>8.16 ± 0.21</td>
</tr>
<tr>
<td>Dissolved oxygen (mL/L)</td>
<td>4.97 ± 1.84</td>
<td>4.8 ± 0.97</td>
</tr>
<tr>
<td>Hardness (ppm)</td>
<td>128.67 ± 63.67</td>
<td>402 ± 213</td>
</tr>
<tr>
<td>Ammonia-N (µg/L)</td>
<td>3.48 ±5.25</td>
<td>8.1 ±0.52</td>
</tr>
<tr>
<td>Nitrite-N (µg/L)</td>
<td>0.26±0.21</td>
<td>0.77±0.33</td>
</tr>
</tbody>
</table>

Regression lines for weights of prawns over the 180 days culture period are presented in Fig. 3. The regression of sample weights on culture days was statistically non-significant (P>0.05) in prawns of M₁ experiment and prawns of M₂ experiment but when the experiments were considered individually the values were significant for M₁ experiment (P<0.01, r = 0.964 and M₂ experiment (P<0.05, r = 0.896). The regression line for prawns of M₁ experiment was not significantly different (P>0.05) from the regression line for prawns of M₂ experiment.

### Discussion

Production in freshwater prawn farming is a function of stocking density.
density, survival, growth rate, seed availability, food quality, water temperature and stress free environment (Weidenbach, 1982). The positive correlation between prawn stocking rate and yield and the negative correlation between stocking rate and individual weight have been previously noted by Sandifer and Smith (1975), Willis and Berrigan (1977), Brody et al. (1980) and Wohlfarth et al. (1985).

Wohlfarth et al. (1985) reported that while the prawn weight per individual decreased from 40 to 24 g, the yield increased from 380 to 791 kg per ha and the proportion of marketable animals decreased from 73 to 20%, when prawn density increased from 1 to 4 animals per m$^2$. But, Sadek and Moreau (1996) observed that stocking at high density (5/m$^2$) was more effective in increasing the net income and the rate of return reached 2 to 5 times more than that with other strategies. D'Abramo et al. (1989) showed that a stocking density between 4 and 6 juveniles per m$^2$ yielded a production of 1,207 to 1,409 kg/ha within five months and it was further stated that around 4 per m$^2$ stocking density was economically attractive. In the present study, mean body weight of prawn decreased from 31.32 to 28.38 g and the estimated gross yield increased from 984 to 1,662 kg per ha in six months when prawn density increased from 5 to 10 juveniles per m$^2$. However, the statistical analysis shows no significant difference (P>0.05) between the growth rates of prawns at two densities.

In freshwater prawn farming, HIG (heterogenous individual growth) has been a common phenomenon (Daniels and D'Abramo, 1994; Tidwell et al, 1994). When high stocking density monoculture is practised, the yield obtained usually consisted of prawns of
wide size range (Smith et al., 1978; Cohen et al., 1983). Roberts and Bauer (1978) reported that reduction of stocking rate resulted in increased mean weight of prawns and the proportion of marketable yield. Similar picture was noticed in the present study also. Over 30% of the prawns in Mj study and 17% in M2 study are marketable (ie>40 g) (Fig. 4). The present study has indicated that growing of prawns at 5 per m² would result in higher mean body weight at harvest and greater market value than raising prawn at a density of 10 per m². This could be compared with the results of D’Abramo et al. (1989), where it was put forth that stocking density around 4/m² would be ideal for M. rosenbergii.

Minor variations were noted in the parameters such as temperature, pH and dissolved oxygen content among the two treatments. Hardness, ammonia-N and nitrite-N showed marked variation. The high population strength in the pond could be attributed as a possible reason for this high rise in the hardness, NH₃-N and NO₂-N. Based on the foregoing, it can be concluded that the stocking of M. rosenbergii at 5 juveniles per m² density will be more advantageous, than 10 juveniles per m².

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References


