Larval production by crossbreeding and artificial insemination of freshwater prawns

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ABSTRACT

Interspecific crossing has been attempted between _Macrobrachium malcolmsonii_ and _M. rosenbergii_ two cultivable freshwater prawns. The respective females successfully produced viable larvae. The hatching rate and survival percentage increases with increase in size of both the species and it was comparatively higher in _M. rosenbergii_ females. In intraspecific insemination trials, three _M. malcolmsonii_ females produced viable larvae and another three shed their eggs. However, four _M. rosenbergii_ females produced viable larvae and two shed their eggs. In interspecific insemination trials, females shed their eggs after about 6 to 8 days of incubation.

Introduction

The giant freshwater prawn _M. rosenbergii_, is an excellent candidate species for aquaculture because of qualities such as rapid growth, good survival, tolerance to wide ranges of temperature and salinity, acceptance of both plant and animal diets, comparatively tamed behaviour, absence of major disease problems, compatibility with non-predacious species of fish, short larval period and high domestic and export value (Ling and Costello, 1976). However, the Godaveri river prawn, _M. malcolmsonii_ compete promisingly with _M. rosenbergii_ in several aspects such as growth rate, feeding habits, lower cannibalistic tendencies, culturability in impounded freshwater, euryhaline adaptability in breeding, fairly good fecundity, larval hardiness in withstanding starvation and heavy turbulence, polyculture possibilities etc (Sankolli and Shakuntala Shenoy, 1978). So there is a possibility of transfer of desired traits from one species to another species by hybridization.

Uno and Fujita (1972) presented a brief report of success in artificial hybridization of the closely related species, _M. formosense_ and _M. nipponense_ but artificial hybridization with other freshwater prawn species have failed (Dobkin _et al._, 1973; Sandifer and Smith, 1976, 1979; Sandifer _et al._, 1977; Shokita, 1978). The crossbreeding of male _M. malcolmsonii_ and female _M. rosenbergii_ was successfully carried out by Sankolli _et al._ (1982). These two species successfully mated but they shed their eggs after about 10 days of incubation (Soundarapandian _et al._, 1995a). The initial attempts involved in mechanical extrusion of spermatophore very often injure males. The electroejaculation technique of extruding...
spermatophore very often injure males. The electroejaculation technique of extruding spermatophore from males has simplified artificial insemination technique in decapods to a certain extent. In the present study two types of experiments were conducted. The first one was aimed at crossbreeding the freshwater prawns *M. rosenbergii* and *M. malcolmsonii* in the natural way and the second was aimed at cross-breeding the freshwater prawns by artificial insemination.

**Materials and methods**

**Experiment I:** The mature males and females of *M. malcolmsonii* (26.08 to 34.10 g) and *M. rosenbergii* (24.52 to 32.19 g) were collected from Manampadi (lat. 11°29’ N and long. 79° 46’E) and transported to the laboratory in oxygenated bags (Soundarapandian *et al.*, 1995b). They were acclimatised to laboratory conditions (temperature 27±2°C; dissolved oxygen 5 ppm; salinity 0.5 ppt) and natural situation was simulated by modifying the environmental parameters as follows. Just over the experimental tank a shower was erected, through which freshwater was sprinkled and artificial light was provided at regular intervals through a 200-Watt bulb. Newly moulted (premating moult; 3 hrs after moult) ripe females were introduced into the spawning tank where respective males of other species were kept. Two experiments were conducted. For each experiment, five different size females were used and for each size, triplicates were maintained. The crossing was done in the following pattern.

1. Male *M. rosenbergii* with female *M. malcolmsonii*

2. Male *M. malcolmsonii* with female *M. rosenbergii*

After mating, the females laid eggs within 24 hrs. The spawned females were transferred to hatching tank and they were maintained until all the larvae hatched out. During maturation, spawning and incubation period, the animals were fed with clam meat. Every morning 50% of the water and left over feed were removed. The total number of eggs, hatched and the survival percentage were calculated for each berried female.

**Experiment II:** The apparatus and methodology used for extrusion of spermatophore was that developed by Samuel *et al.* (1998). The electroejaculated spermatophore retrieved from the male prawn was placed on the sperm receptacle area of the female. The artificially inseminated female was then freed into a tank. The complete process of artificial insemination normally takes 3 to 5 minutes. Totally four experiments were conducted; two intraspecific insemination and the other two interspecific. The fertilization of artificially inseminated females was confirmed by observing cleavage, two or three days after oviposition. The artificial insemination was done in the following pattern.

1. Male *M. malcolmsonii* with female *M. malcolmsonii*.

2. Male *M. rosenbergii* with female *M. rosenbergii*.

3. Male *M. rosenbergii* with female *M. malcolmsonii*.

4. Male *M. malcolmsonii* with female *M. rosenbergii*. 
Results and discussion

In the present study, the number of fertilised eggs, hatching rate and survival percentage of both the species were generally low and it was marginally higher in *M. rosenbergii* (Table 1). In both the species the fertilised eggs, hatching rate and survival percentage gradually increased with increase in size. The mating process and spawning were almost similar to the cross-breeding observed by Soundarapandian et al. (1995 a). However, in their interspecific crosses (male *M. rosenbergii* with female *M. malcolmsonii*), the female spawned normally but dropped off their eggs after 2 - 3 days. Some of the experimental females (male *M. malcolmsonii* with female *M. rosenbergii*) also shed their eggs prematurely after about 10 days of incubation. In the present experiment, no such event happened. All the females successfully spawned, incubated and hatched normally (Table 1). The crossbreeding experiments by Soundarapandian et al. (1995b) were successful but the hatching rate and survival percentage were very low. The surviving larvae were also not active. Larvae in weak conditions were sluggish, did not respond well to feed, were not sturdy to swim against the air bubbles, accumulated at the bottom of the tank and were often bluish in colour.

The electroejaculation of spermatophore has been reported as the most effective and simple method of spermatophore retrieval in *Macrobrachium* species (Sandifer and Lynn, 1980). In the present work, electrical stimuli of 3.2 to 11.1 V and 5 to 6 V have been found to be sufficient for extrusion of spermatophore in male *M. malcolmsonii* (Samuel et al., 1998) and *M. rosenbergii* (Sandifer and Lynn, 1980) respectively. In the first trial of the present experiment (male *M. malcolmsonii* with female *M. malcolmsonii*) three females shed their eggs immediately after insemination. Another three females produced viable larvae after a brief period (21 days) of incubation. In the second trial (male *M. rosenbergii* with female *M. rosenbergii*) only four females produced viable larvae. In both the experiments, survival rate of the larvae was very low (Table 2). Sandifer and

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Average weight of females (g)</th>
<th>Number of Eggs (number)</th>
<th>Hatching (%)</th>
<th>Survival (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I 1</td>
<td>26.08 ± 0.62</td>
<td>20461 ± 64.21</td>
<td>8.81 ± 0.52</td>
<td>3.98 ± 0.84</td>
</tr>
<tr>
<td>I 2</td>
<td>29.18 ± 0.74</td>
<td>23404 ± 82.62</td>
<td>10.49 ± 0.93</td>
<td>4.67 ± 0.69</td>
</tr>
<tr>
<td>I 3</td>
<td>29.37 ± 0.98</td>
<td>25409 ± 10.54</td>
<td>10.79 ± 0.54</td>
<td>4.83 ± 0.17</td>
</tr>
<tr>
<td>I 4</td>
<td>32.17 ± 0.40</td>
<td>27345 ± 59.72</td>
<td>10.92 ± 0.08</td>
<td>4.90 ± 0.02</td>
</tr>
<tr>
<td>I 5</td>
<td>34.10 ± 0.70</td>
<td>29882 ± 58.28</td>
<td>11.03 ± 0.08</td>
<td>4.98 ± 0.12</td>
</tr>
<tr>
<td>II 1</td>
<td>24.52 ± 0.54</td>
<td>23445 ± 69.46</td>
<td>10.27 ± 0.65</td>
<td>4.08 ± 0.17</td>
</tr>
<tr>
<td>II 2</td>
<td>25.62 ± 2.14</td>
<td>26364 ± 65.39</td>
<td>10.61 ± 0.57</td>
<td>4.37 ± 0.48</td>
</tr>
<tr>
<td>II 3</td>
<td>28.99 ± 0.31</td>
<td>29330 ± 52.92</td>
<td>11.00 ± 0.28</td>
<td>4.78 ± 0.36</td>
</tr>
<tr>
<td>II 4</td>
<td>30.19 ± 0.76</td>
<td>31281 ± 8.19</td>
<td>11.04 ± 0.16</td>
<td>4.50 ± 0.12</td>
</tr>
<tr>
<td>II 5</td>
<td>32.19 ± 1.03</td>
<td>33210 ± 12.25</td>
<td>11.65 ± 0.53</td>
<td>5.14 ± 0.32</td>
</tr>
</tbody>
</table>
Smith (1979) also reported success in 5 to 6 intraspecific artificial insemination trial in *M. rosenbergii*. The larvae produced appeared normal. They repeated the artificial insemination experiments using electrically ejaculated spermatophores. All the 19 females inseminated spawned and 11 produced fertilised eggs. In the 3rd and the 4th experiment, eggs were successfully fertilised by artificial insemination. However, the females shed their eggs after a brief period (6 days for *M. malcolmsonii* and 8 days for *M. rosenbergii*) of incubation. The marginal success only of the present artificial insemination study is perhaps due to stress experienced by the animals. Sandifer and Smith (1979) observed that females handled frequently after moulting often postponed spawning or completely resorbed the ovaries. The artificial insemination technique has been already performed by different workers (Sandifer and Lynn, 1980; Lumare, 1981; Bray et al., 1982; Lin and Ting, 1985; Joshi and Diwan, 1992; Kannupandi, 1995).

Acknowledgment

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References


Samuel, M.J., T. Kannupandi and P. Soundarapandian 1998. Assessing the suitable position for electrode placement and electroejaculation on different size
males of the cultivable prawn Macrobrachium malcolmsonii (H. Milne Edwards).


