Performance of Giant Freshwater Prawn (*Macrobrachium rosenbergii* de Man) Reared in Earthen Ponds Beneath Plastic Film Shelters

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**ABSTRACT**

This study investigated the effects of using plastic film shelters on the survival, growth and production cost of giant freshwater prawn (*Macrobrachium rosenbergii*). Three ponds were covered with plastic shelters, whilst three other were left unsheltered as controls. The surface area of all ponds was 100 square meters (6x16.7), with a water depth of 1.0 meter. Post larvae (0.012 g, mean initial weight) were raised with a stocking density of 100 individuals/m². They were grown for 75 days in both treatments. The average temperature of the pond water beneath the film was 3.4°C higher than that of unsheltered ponds. In sheltered ponds, the lowest temperature recorded was 23°C, whereas in non-sheltered ponds the lowest recorded temperature was 18°C. The minimum and maximum temperatures (on average) in the non-sheltered ponds and sheltered ponds were 23.8-27.4°C and 27.7-30.3°C, respectively.

Although there was no significant difference in the prawn’s survival rate, the growth rate and food conversion ratio between treatments were significantly different (*P*<0.05). Weight gain of post larvae reared in non-sheltered ponds was 0.037±0.002 gram per day, compared with 0.062±0.002 gram per day for larvae in sheltered ponds. The mean final weight of the prawns raised in sheltered ponds was higher (5.42±0.18g) than that of prawns raised in non-sheltered ponds (2.70±0.16 g). The production cost of using sheltered ponds was lower compared to the cost using non-sheltered ponds. Variation in size of the prawns among ponds with plastic covering was lower than the non-sheltered ponds. Therefore, using plastic film covering over nursing ponds resulted in higher growth performance and lower production cost. It is therefore a promising method for farmers to rear post larvae during the cold season.

**Keywords:** giant freshwater prawn (*Macrobrachium rosenbergii*), plastic film covering, low temperature area.

1. **INTRODUCTION**

Giant freshwater prawn is a high valued cultured species, because of its wide acceptance to consumers due to its dainty taste, ease of culture and it has export potential. This prawn is indigenous to most Southeast Asian and South Pacific countries [1, 2]. Since
its successful domestication in the late 1960s [3], the culture of freshwater prawn has gained popularity worldwide, mostly in the tropics and subtropical regions [4]. In recent years (2000 to 2003), global production of freshwater prawn has increased rapidly with the most production in East and South Asian countries. China is the biggest producer of freshwater prawn with an average of 128,338 tons per year, Vietnam produces 28,000 tons per year, while India produces 24,230 tons per year, and Thailand produces 12,067 tons per year. [5], Freshwater crustacean production in the region reaches 0.5 million tons per year.

In Thailand, the annual production of giant freshwater prawn averaged about 8,300 tons in 1989-1998, peaking in 1992 (10,306 tons) and 1994 (10,124 tons) [6]. Freshwater prawn production has increased gradually. In the recent year (2001), production reached 13,300 tons [7]. Domestic consumption was 70% of total production [8]. The prawns can be cultured in all freshwater bodies (Dams, Lakes, Rivers, Reservoirs, Fishponds, etc.). Most of the production comes from the central part of Thailand. A few tons of giant freshwater prawns, both frozen type and living are transported from the central region to the northern region of Thailand. Although, some areas in the North are suitable for raising freshwater prawns such as Chiangrai and Pijit provinces, production is not enough to support the market demand. However, there is a high potential to increase production to cater for high consumption rates in the tourist cities of the northern region.

Furthermore, freshwater prawn culture is being adapted by farmers in the Northern area. New appropriate techniques are required to cope with low temperatures during the cold months which is one of the major factors affecting the growth of prawns. Hence, a green house type system might be useful to raise the water temperature and increase the survival of the prawns during cold the season. The objectives of this study were 1) to evaluate the effects of plastic covering nursery ponds during the cold season; and 2) to investigate the growth, survival and production costs of freshwater prawn nursed in earthen ponds with and without plastic shelters.

2. MATERIALS AND METHODS

2.1 Plastic Film Sheltering

Six experimental earthen ponds were divided into 2 treatments (1) Three ponds were sheltered by plastic film; and (2) Three ponds were left unsheltered as controls. Each pond had the total surface area of 100 square meters (6x16.7m) and all were located at the faculty of Fisheries Technology and Aquatic Resources, Maejo University, Chiang Mai, Thailand. Clear plastic films (50 micro meters thick) were used to make shelters over the experimental ponds, supported by iron frames.

2.2 Pond Preparation, Stocking and Stocking Rate

Prior to stocking, the ponds were dried for two weeks until the pond bottom was cracked to eliminate unwanted species like predators. Then, hydrated lime was applied (60kg/rai). The water was filtered to exclude predators. The ponds were initially filled with water to a depth of 10-15 cm followed by application of an inorganic fertilizer (16-20-0 ammonium phosphate) at the rate of 6 kg/rai. Seven to ten days after that, the ponds were filled with water to 80 cm. The post larvae were acquired from a private hatchery in Petchaburi province. Post larvae were acclimatized for at least 20 minutes prior to stocking. The stocking density was 100 post larvae /m² and the size of post larvae was PL-15. An air pump was installed in each pond to sustain oxygen requirements. Air was pumped though holes in PVC pipes.

2.3 Feeds and Feeding Rate

In this study, commercial pellet feed (CP Group) containing crude protein, crude fat, crude fiber and moisture of 35%, 5%, 4%, and 12%, respectively, was provided.
Feeding was carried out three times a day in the morning (8:00), at noon (12:00) and afternoon (5:00) at 30.0%, 20.0% and 50.0% of daily ration, respectively. The feeding rate was 20% of the total bio-mass for the first 0-15 days, 15% of body weight from 16 to 30 days old, and from 31 to 45 days old 10% of the total bio-mass was given, and 5% of the total bio-mass for 46 to 75 days old (Table 1). The feeding rate was adjusted by data sampling and estimating total bio-mass every 15 days. The pellets were thrown over the ponds.

Table 1. Feeding rate for young giant fresh water prawns [9].

<table>
<thead>
<tr>
<th>Age (days)</th>
<th>Feeding rate (%/body weight/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-15</td>
<td>20</td>
</tr>
<tr>
<td>16-30</td>
<td>15</td>
</tr>
<tr>
<td>31-45</td>
<td>10</td>
</tr>
<tr>
<td>46-75</td>
<td>5</td>
</tr>
</tbody>
</table>

2.4 Production Costs

The production cost in each treatment was recorded. Both treatments were provided with the same conditions (e.g. water management, feeding frequency, and feeding rate as well as quality of feeds). The costs differed only in the construction of the shelter. Non-sheltered ponds had no additional costs of production. Production cost was calculated as sum of all the expenses (e.g. sum of total fixed cost, variable cost, opportunity long and short cost) divided by the number of surviving prawns.

2.5 Data Collection and Analysis

The weight of prawns was determined every 10 days. Two hundred individuals were collected from the population in each pond and weighed to provide the necessary adjustment of the feed. Water quality parameters were measured in situ (DO, pH, and ammonia-nitrogen), chlorophyll-a and phytoplankton were determined every 15 days from 0900-0100 hours[10]. Paired t-test was used to evaluate the indicated parameters.

3. RESULTS AND DISCUSSION

3.1 Effect of plastic covering on water temperature in nursing ponds.

In the early stages (1-45 days), the temperatures of both treatments were kept constant and in the last stage (days after 45) the temperature decreased gradually. The minimum and maximum temperatures of water in the sheltered ponds are shown in figure 2. Water temperature in sheltered ponds and non sheltered ponds (ave. min. max) were 27.7-30.3 °C and 23.8-27.4 °C, respectively. The lowest temperature in sheltered ponds and non-sheltered ponds after 65 days was 23.0 and 18.0 °C, respectively (Table 2). Hence, at the lowest temperatures, sheltered ponds were warmer than non-sheltered ponds.

3.2 Growth, Survival, Food Conversion rations and Size Distributions.

The final weight, growth rate and feed conversion ratio differed significantly (p<0.05) between treatments (Table 3). Although the production costs of prawn in the sheltered ponds was higher than in non-sheltered ponds, the final mean weight of prawns from sheltered ponds was 5.42g while the final mean weight from the non-sheltered ponds was 2.7 g (Figure 3). Plastic shelters therefore
improved the growth and survival of post larval prawns specifically during the cold season of the year.

Freshwater prawns are tropical animals. For this reason, water temperature affects food consumption, digestion rate, growth, assimilation and respiration on crustacean behavior [11]. Water temperature of 26-31 °C is considered satisfactory for freshwater prawn growth [12]. However, 29-31 °C is the optimal temperature for prawn culture [13]. In northern Thailand, the temperature decreases in the cold season. The increase in water temperature through the use of plastic film enhanced the growth of freshwater prawns.

Table 2. Mean water temperature range in the ponds nursed from October 2004 to January 2005.

<table>
<thead>
<tr>
<th>Items</th>
<th>Unsheltered Ponds (°C)</th>
<th>Sheltered ponds (°C)</th>
<th>Temperature Differences (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowest water temperature</td>
<td>18.0</td>
<td>23.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Highest water temperature</td>
<td>34.0</td>
<td>33.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Average minimum water temperature</td>
<td>23.8</td>
<td>27.7</td>
<td>3.9</td>
</tr>
<tr>
<td>Average maximum water temperature</td>
<td>27.4</td>
<td>30.3</td>
<td>2.9</td>
</tr>
<tr>
<td>Average temperature difference</td>
<td>3.6</td>
<td>2.6</td>
<td>-</td>
</tr>
<tr>
<td>Average water temperature</td>
<td>25.6</td>
<td>29.0</td>
<td>3.4</td>
</tr>
<tr>
<td>Temperature daily interval</td>
<td>0-12</td>
<td>0-6</td>
<td>-</td>
</tr>
</tbody>
</table>

Figure 2. Minimum and Maximum mean water temperatures in experimental ponds, (From October 10 2004 to December 15 2004).
Table 3. stockling rate, mean final weight and growth rate of giant freshwater prawns after 75 days in sheltered and unsheltered ponds.

<table>
<thead>
<tr>
<th></th>
<th>Sheltered ponds</th>
<th>Unsheltered ponds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stocking rate (pcs./m²)</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Nursing period (day)</td>
<td>75</td>
<td>75</td>
</tr>
<tr>
<td>Initial weight (g.)</td>
<td>0.02+0.01&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>0.02+0.01&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
<tr>
<td>Final weight (g.)</td>
<td>5.42+0.18&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.70+0.16&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Growth rate (g./day)</td>
<td>0.062+0.002&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.037+0.002&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Survival rate (%)</td>
<td>54.0 %&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>55.0 %&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
<tr>
<td>Feed conversion ratio</td>
<td>2.3+0.4&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4.8+0.1&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Cost (Baht/kg.)</td>
<td>300.73&lt;sup&gt;b&lt;/sup&gt;</td>
<td>492.59&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Mean values in the same row sharing the same superscript are not significantly different (P> 0.05)

Figure 3. Mean weight of giant freshwater prawn in sheltered and unsheltered ponds

Figure 4. Distribution of body weight of giant freshwater prawns (n=300) in sheltered and unsheltered ponds.
Owing to the greater size and lower feed conversion ratio of prawns nursed in sheltered ponds, the production cost of prawns (Baht/Kg) nursed in plastic covered ponds (300.73 Baht/Kg) was lower than that in non-sheltered ponds (492.59 Baht/Kg) (Table 3). Although the plastic covering and iron frame increased the cost of production was much higher 87.8 kg total weight in contrast to 44.5 kg from the non-sheltered ponds. Therefore the production cost per kilogram was much lower in sheltered ponds than in non-sheltered ponds. The size distribution of juveniles from the sheltered ponds was narrower than in non-sheltered ponds (Figure 4) were significantly different \( P > 0.05 \) between treatments.

3.3 Water Quality and Phytoplankton

Water quality was within optimal ranges.

![Figure 5. Average DO(a), pH(b), chlorophyll a (c) and ammonia (d) (mean's SD) in sheltered and unsheltered ponds.](image)

![Figure 6. Composition of division of phytoplankton in sheltered and unsheltered ponds.](image)
During the nursing stage, no differences in DO, pH, chlorophyll a and ammonia-nitrogen (Figure 5) between treatments were observed. The average amount of DO, pH, chlorophyll a and ammonia-nitrogen in the nursing stage in sheltered ponds and unsheltered ponds were 5.17 and 5.23 mg/L, 8.04 and 7.99, 0.22 and 0.22 mg/L, 76.95 and 75.33 mg/L, respectively. The plastic covering had no effect on pH (p<0.05). The pH in the ponds was within the optimal range of 7.0-8.5. In this study, total ammonia was 0.22mg/l at pH 7.99-8.04 well within acceptable levels in both treatments. This condition had no adverse effect to prawn due to the low concentration of un-ionized form.

3.4 Phytoplankton

The composition of the divisions of phytoplankton in the ponds is shown in Figure 6. Cyanophyta and chlorophyta were the two dominant divisions found in sheltered ponds and non-sheltered ponds at percentage levels of 38 %, 35% and 36%, 32%, respectively.

5. Conclusions

Plastic film increased the temperature of the pond water and increased the growth rate of the prawns. Size distribution of juveniles obtained from ponds with plastic covering was narrower than that of non-sheltered ponds. In addition, production cost of sheltered pond was lower than that of the unsheltered ponds.

Acknowledgements

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6. Reference

