A Comparative Study of Different Methods for Larval Selection on Survival Rate, Growth and Yield of Black Tiger Shrimp (*Penaeus monodon* Fabricius)

Supakorn Pattanavivat, Chalor Limsuwan, Niti Chuchird* and Nitis Pattarakulchai

Department of Fisheriey, Faculty of Fisheries, Kasetsart University,
Bangkok 10900, Thailand

ABSTRACT

Since 2000, black tiger shrimp (*Penaeus monodon*) production in Thailand has decreased because of the slow growth syndrome, poor survival and lack of predictability of postlarval (PL) performance in the growout phase. To solve these problems, many criteria were developed to assess larval quality before stocking in the growout pond. In this study, three methods for selecting PL were compared: group 1 using the Shrimp Biotech method; group 2, the Wanachsunthorn method; and group 3, conventional method (control). The shrimp were raised in growout ponds (15 ponds for each group) with low saline (1-5 ppt) water at a density of 80,000 PL per rai (1,600 m^2) for 120 days. The results showed that the yield and survival rates of shrimp in group 1 were 987.60±170.25 kg/rai and 67.91±10.54% compared with 882.86±136.36 kg/rai and 66.18±10.34% in group 2. There were no statistically significant differences between the two groups. However, there were significant differences in the production and survival rates in group 3 which were 491.53±81.06 kg/rai and 45.24±7.11%, respectively. The results from this study indicated that evaluation of several criteria in groups 1 and 2 gave a better quality of shrimp seed and were major factors affecting the survival rate and production of cultured shrimp.

Keywords : Postlarvae, Shrimp Biotech method, Wanachsunthorn method, Black Tiger Shrimp (*Penaeus monodon*)

INTRODUCTION

Black tiger shrimp used to be a major export item that earned 100 billion baht for Thailand yearly. But starting in 2002, the production of black tiger shrimp has dropped because harvests were not up to target. The shrimp grew slowly and many were small-sized (Limsuwan and Chanratchakool, 2004). Although stunted growth may result from a variety of causes, the quality of shrimp postlarvae (PL) is considered to be one of the most important factors influencing successful shrimp culture. Healthy PL reared in a good environment have the best chance of growing well and achieving good survival, harvests and profits (Saurabh *et al.*, 2006). Stress tests have been described and applied principally to distinguish between healthy and weak PL based on the exposure of shrimp to

environmentally adverse conditions (Maugle, 1988; Baybay, 1989; Tackarert *et al.*, 1989; Bauman and Jamadre, 1990; Bauman and Scura, 1990; Niestes, 1990; Gromez *et al.*, 1991). These include stress tests of salinity shock or salinity and temperature or to selected chemical solutions such as formalin (Briggs, 1992; Clifford, 1992; Tackaert *et al.*, 1989; Bauman and Jamandre, 1990). However, there is no reported evidence that the results of these stress tests are related to performance of PL during culture and growout (Aquacop *et al.*, 1991; Fegan, 1992; Samocha *et al.*, 1998; Racotta *et al.*, 2003).

Assessment PL health and fitness has become increasingly important and a major concern at both the research and production levels (Tayamen and Brown, 1999; Racotta *et al.*, 2003). Many different criteria have been used, including simply the stage of development from zoea 1 to PL, coloration, gut fullness, PL survival, muscle development, body deformity, presence of debris on setae, fatty acid profile composition, and the presence of virus occlusions has also been considered (Parado-Estepa, 1988; Browndy, 1992; Samacha and Lawrence, 1992; Banman and Jamandre, 1990; Villalon, 1991; Arellano, 1990; Gacutan and Grijado, 1996).

In this study three different methods commonly used in Thailand for evaluating the quality of shrimp PL were compared, determining any relationship to yield and growth rate of black tiger shrimp in the growout pond.

MATERAILS AND METHODS

The *P. monodon* larvae used in this study were produced by a private hatchery located in Phuket province, Thailand. All the larval stage nauplii came from white spot syndrome virus (WSSV)-free broodstock. Larvae were reared until they reached PL15 and then randomly divided into three groups for evaluation of PL quality using three different methods. Group1 used the Shrimp Biotech method; group 2, the Wanatsunthorn method; and group 3, the conventional method (control), by observing only the normal appearance of the PL. Parameters used for each method are shown in Table 1.

PL from each group that passed the evaluation tests were transferred to a private shrimp farm in Ratchaburi province and stocked at a density of 80,000 PL/ 1,600 m^2 in 45 earthen ponds, with 15 ponds for each group. The ponds' areas ranged from 4,800-6,400 m^2 (3-4 rai). Salinity during the culture period ranged from 3-5 parts per thousand (ppt). Shrimp were fed with a commercial pelleted feed four times daily and feed quantity was adjusted following Limsuwan and Chanratchakool (2004). After 120 days the shrimp were harvested. Subsequently, shrimp from each pond were divided into two body weight groups: normal shrimp of more than 6 g and stunted shrimp under 6 g. Means and standard deviations of production, weight gain, FCR and survival rate of the shrimp from the three groups were calculated and compared using a one way analysis of variance (ANOVA).

Table 1. Comparison of three methods for selection high-health PL in this study.

Criteria	Shrimp Biotech method	Wanachsunthorn method	Conventional method
WSSV-free	Using PCR method	Using PCR method	Using PCR method
Sight inspection	1. Color condition. 2. Gut fullness. 3. Uniform size. 4. Swimming activity and behavior.	1. Condition of antennules 2. Coloration of uropods 3. Swimming activity and behavior	Same as Shrimp Biotech method
MBV	5. Detection of occlusion bodies with light microscope	no	no
Condition of the hepatopancreas	6. Coloration and size of the hepatopancreas	no	no
Lipid vacuoles	7. The amount of lipid vacuoles	no	no
Physical deformities	8. Necrosis and physical deformities of appendages	no	no
External parasites	9. Observation of external parasites	4. Observation of external parasites	no
Muscle to gut ratio	10. Observation of muscle to gut ratio (4:1)	5. Observation muscle to gut ratio (4:1)	no
Bacterial count on TCBS	11. *Vibrio* count (yellow colony 100 and green colony < 10)	no	no
Antibiotic residues	12. Detection of antibiotic residues	no	no
Average body weight	13. Average body weight at PL_{15} stages	no	no
Stress test	Salinity stress test	6. Formalin stress test	no

Table 2. Statistical differences between the production of selected PL by three methods.

Parameter	Method	Average
Average weight (g)	Shrimp	17.1267^{a} (± 2.65455)
	BiotechWanatsunthorn	16.1160^{a}(± 2.32785)
	Conventional (control)	12.5260^{b}(± 2.61953)
Production (kg/1,600 m^2)	Shrimp	987.6000^{c}(± 170.75873)
	BiotechWanatsunthorn	882.8667^{c}(± 136.36761)
	Conventional (control)	491.5333^{d}(± 81.06511)
Percent of normal shrimp after harvest (weight > 6 g)	Shrimp	94.8133^{e}(± 2.62811)
	BiotechWanatsunthorn	89.1333^{f}(± 2.70123)
	Conventional (control)	92.9000^{e}(± 2.17650)
Percent of stunted shrimp after harvest (weight < 6 g)	Shrimp	5.1533^{g}(± 2.63923)
	BiotechWanatsunthorn	10.8667^{h}(± 2.70123)
	Conventional (control)	7.1000^{g}(± 2.17650)
Weight gain/day (g)	Shrimp	0.1495^{i}(± 0.02405)
	BiotechWanatsunthorn	0.1373^{i}(± 0.02201)
	Conventional (control)	0.1039^{j}(± 0.02103)
Percent of survival rate (%)	Shrimp	67.9133^{k}(± 10.54716)
	BiotechWanatsunthorn	66.1867^{k}(± 10.34241)
	Conventional (control)	45.2400^{l}(± 7.11295)
Feed conversion rate (FCR)	Shrimp	1.3333^{m}(± 0.08398)
	BiotechWanatsunthorn	1.4313^{m}(± 0.13464)
	Conventional (control)	2.1793^{n}(± 0.29436)

Mean values with different superscripts are significantly different ($P<0.05$)

RESULTS AND DISCUSSION

The results are shown in Table 2. There were no statistically significant differences between the total production, average weight, weight gain/day, survival rate and FCR of the shrimp in groups 1 and 2. However, the results of these two groups were significantly higher than those of group 3. Groups 1 and 2 had similar results for most parameters except percentage of small-sized shrimp. In this study PL that passed the evaluation method in group 1 had a lower percentage of small-sized shrimp than group 2. This might have been because the Shrimp Biotech method (group 1) had more criteria for PL selection and was more concerned with the condition of the hepatopancreas, especially the detection of *monodon* baculovirus (MBV) occlusions and the amount of lipid vacuoles. Flegel (2006) suggested that even though MBV is not a serious pathogen for the black tiger shrimp (Liao *et al.*, 1992; Fegan *et al.*, 1991), it should be eliminated from the farming system because it is unlikely that shrimp could carry such heavy viral infections without any effect on the shrimp. Flegel *et al.* (2004) showed that the mean length of MBV infected shrimp was significantly shorter than that of uninfected shrimp from the same pond. This report supported our results in

that the shrimp in group 1 showed a higher percentage of normal shrimp (weight> 6 g) than in group 2, although there is very little information available regarding the coloration and the amount of lipid vacuoles in the hepatopancreas. Good quality PL should have a dark color with star-like brown or dark pigmentation. The presence of a relatively large hepatopancreas with a large amount of lipid vacuolation is considered to be a sign of good health. PL with a small hepatopancreas containing few lipid vacuoles is a sign of underfeeding (Saurabh *et al.* 2006).

The occurrence of deformities of appendages and average body weight of PL were also criteria for PL selection in group 1. Healthy PL are generally more aggressive in searching for food and have a better chance of survival in the growout ponds than the deformed PL (Vittalon, 1991; Clifford, 1992; Smith *et al.*, 1992; Saurabh *et al.*, 2006). Postlarval size (length, wet weight) is a direct indicator of growth and thus reflects the degree of development at a given moment. Increased growth and reduced variability in size during PL stages has in turn been related to further growth to juvenile stages (Racotta *et al.*, 2003; Castille *et al.*, 1993; Samocha *et al.*, 1989; Bray and Lawerence, 1992).

In addition to the criteria described above, the Shrimp Biotech method (group 1) had two more criteria for selection of good quality PL. One was *Vibrio* spp count on TCBS agar. Another one was antibiotic residues check. *Vibrio* spp, have been reported to cause larval mortalities in hatcheries and pond reared black tiger shrimp (Sunaryanto and Mariam, 1986; Baticados *et al.* 1990; Lavilla-Pitogo *et al.*, 2000). It is a common practice for the farmer to give antibiotic dip treatment for broodstock and larvae in hatcheries to reduce the shrimp mortality rate (Otta *et al.*, 2000; Liu *et al.*, 1997). Moriarty (1999) suggested that many farmers also use large quantities of antibiotics as prophylactics, even when pathogens are not evident. This has led to an increase in more virulent pathogens because of the transfer of genes for antibiotic resistance. Considering this aspect, using good hatchery management practices will improve the quality of PL produced.

It could be concluded that the quality of shrimp seed is a major factor affecting production in shrimp culture. The larval selection methods investigated in this study could be applied to establish an effective system for producing and distributing good quality PL to the farmer. Specific pathogen-free and genetically improved broodstock will also be required for the future successful development of commercial black tiger shrimp farming.

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