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Comparison of all morphotype males and various types stocking density of *Macrobrachium rosenbergii* (De Man) on growth and survival rate

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A B S T R A C T

A study was conducted to apprais[illegible]he effect of di[illegible]rent stocking densities on three male morphotypes named blue claw (BC), orange clav[illegible]C) and smal[illegible]le (SM) at harvest in all-male culture and assess the growth performance of BC, OC and [illegible] each isol[illegible] culture. Trials involving three stocking densities of all-male prawn viz., 20, 30 and 40 juv[illegible] m^{-2} [illegible]e carried out in replicates. After 4 months of culture, BC, OC and SM were [illegible]m all tanks a[illegible]stocked at 5 m^{-2} in treatments BC, OC and SM respectively for 80 days. A differen[illegible]n p[illegible]nsity was significant ($P < 0.05$) affect adversely on morphotypes. The highest survival rate co[illegible]ined [illegible]yields performance was from 20 juvenile m^{-2} stocking density with 21% BC, 62.5% OC a[illegible]16[illegible]SM respectively. In isolation culture, the average specific growth rate of the SM p[illegible]n (1.22) [illegible]ignificantly higher than that of the OC (1.01) and the BC (0.43) population. The su[illegible]al ra[illegible]f the SM[illegible]pulation was 100% while others were 72%. Absolute weight of prawn was sig[illegible]antly gr[illegible]er in the [illegible]male (23.87 g) than the SM (19.57 g) and the BC male (6.31 g). Impacts of iso[illegible] cult[illegible]lation structure were much more pronounced in the SM population than others.

1. Introduction

As all-male freshwat[illegible]prawn[illegible]acrobrachium rosenbergii* (De Man, 1879) culture yie[illegible]ett[illegible]outputs than mixed sex or all-female culture (Cohen et a[illegible]88; Nai[illegible]al., 2006; Kunda et al., 2009), they disp[illegible]rentia[illegible]wt[illegible]at contributes to the wide variation in [illegible] wit[illegible] male p[illegible]tions. Males *M. rosenbergii* however, [illegible]bit het[illegible]geneous individual growth (HIG), in some instances pr[illegible]zed small males (SM), 40% orange-clawed males [illegible] that are larger than SM, and only 10% large blue-clawed male[illegible]C) at harvest (Ra’anan et al., 1991). Thus, HIG is one of the major [illegible]blems affecting profitability in freshwater prawn culture (Karplus et al., 2000) as demand and market price of prawn depend largely on individual size.

Four social mechanisms are controlling factors for growth variation such as direct competition for food, appetite suppression in subordinate individuals, decreased food conversion efficiency and increased motor activity (Karplus, 2005) as well as genetic variation (Banu et al., 2015a). For management of size variation, early researchers have been practiced several ways: supplementary shelters (Peebles, 1979; Smith and Sandifer, 1979; Cohen et al., 1983; Tidwell et al., 2002; Uddin et al., 2009), selective harvesting (Garcia-Perez, 1999; Jose et al., 2007; Rahman et al., 2010), claw ablation (Harpaz et al., 1987; Sagi >and Afalo, 2005; Rahman et al., 2010), size grading (D’Abramo et al., 1991; Daniels and D’Abramo, 1994; Daniels et al., 1995; Tidwell et al., 2003, 2004a,b) eyestalk ablation (Banu et al., 2014) and cold shock (Banu et al., 2015b). A practical management strategy, selective harvesting of BC, has been proposed to enhance the growth rate of SM, thereby minimizing the size variation of males and increasing the total productivity from ponds (Sagi and Afalo, 2005; Rahman et al., 2010). According to Karplus et al. (1989) large second pair of claws of BC prawns is responsible for the stunting of growth of small males (SMs). However, stunting of SMs may be completely eliminated by removing the BC males from the culture systems (Karplus, 2005). Harvesting of BC males were conducted and SM individuals left in the pond

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to grow to larger size and hence to enhance overall biomass in polyculture system. (Rahman et al., 2010).

Hence, the present investigation was focused on male morphotypes of freshwater prawn *M. rosenbergii.* The aim of current study was to determine the effect of different stocking densities on male morphotypes in all-male culture and to evaluate the effect on growth and survival of BC, OC and SM in isolation culture.

2. Materials and methods

2.1. Tank preparation and stocking

The experiment was conducted in the Centre of Marine Science at Port Dickson, Negeri Sembilan, Malaysia for a period of 120 days from February to June 2012. Nine fiberglass tanks (volume 1 ton) were selected for three stocking densities of male freshwater prawn: 20, 30 and 40 juvenile m^{-2} (herein called treatments R_{20}, R_{30}, R_{40} respectively) with three replications, using completely randomized design. Lime ($CaCO_3$) was applied before filling tank up water from reservoir tank. Lime was liquefied into an earthen pot and then applied by spreading homogenously into the tanks. Water preparation was done one week before stocking juveniles. Each tank was aerated by an air stone supplied with air from a regenerative blower. The water depth was maintained around 0.5 m with keeping good water quality and water was exchanged at 50% every week. Water temperatures in all experimental tanks were maintained at (27.34 ± 0.66) °C.

Total length of nursery period was 2 months. Males and females juveniles of *M. rosenbergii* are larger than 3.5 cm total length can be easily identified (Janseen, 1987). It can be manually segregated with accuracy of more than 95% by skilled persons (Nail and [illegible] 2005). The segregation of male juvenile of *M. rosenbergii* was [illegible] manually on the basis of external morphological characteristi[illegible] by visually examining at the area of the base of the last pereop[illegible] The gap between the origins of the two walki[illegible] is less [illegible] case of males and in addition they possess a [illegible]id-li[illegible] coverin[illegible] that hides the genopore. The male juveniles [illegible] *M. rose[illegible]rgii* were collected from a commercial farm Aquacul[illegible] ha[illegible], Negeri Sembilan. Juveniles were brou[illegible] to the [illegible]erimental site by plastic bag equipped with aerat[illegible]. The bags w[illegible] kept underwater in the experimental tanks f[illegible] 30 min accli[illegible]ization of temperature. Individual mean s[illegible]cking [illegible]ght (−x ± S.D) for each treatment was: 1) R_{20}, 5.80 [illegible]09 g; 2) R_{30}, [illegible] ± 0.07 g; and 3) R_{40}, 5.83 ± 0.44 g. Tanks wer[illegible]ndomly assigne[illegible] receive juveniles from one of three tre[illegible]ents. [illegible]ter was provided in each tank to reduce cannibalis[illegible] pra[illegible]. The length and weight of around 10% prawn juveniles of [illegible] tank wa[illegible]easured and recorded for estimating in[illegible]king [illegible]ass[illegible] to adjust initial feeding rate for prawn[illegible]

2.2. Fee[illegible]d f[illegible]

Prawns we[illegible]d with commercial pelleted feed containing 34% protein (BLANCA, [illegible]4, Star feedmills (M) SDN BHD) daily at a rate of 6% of body weight for 1st month, 4% of body weight for 2nd month and 3% of body weight for rest of the cultured period (D'Abramo et al., 1995). Half of the required feed for a day was supplied in the evening and the rest in the morning. Feed rate was calculated and adjusted after sampling of prawn twice in a month.

2.3. Samples

Freshwater prawns were sampled biweekly using scoop net to assess growth and health condition. At least 5 prawns from each tank were taken to make assessment of growth trends and to readjust feeding rate. Prawns were handled carefully to avoid stress during sampling. On the last two samples prior to harvest, prawns were also individually weighed and clas[illegible] one of three male morphotypes: blue claw (BC), orang[illegible]aw (OC[illegible]d small (SM) as described by Cohen et al. (1981), [illegible]s et al. (19[illegible]) and modified by D'Abramo et al. (1989).

Table 1
Range and mean (SD) of the water quality parameters were measured in all tanks.

Parameters	Range	Mean ± SD
Dissolved oxygen (mg L^{-1})	5.61–8.32	7.5 ± 0.23
Temperature (°C)	25.47–29.93	27.34 ± 0.66
pH	7.39–9.18	7.98 ± 0.29
NH_3-N (mg L^{-1})	0.47–2.37	0.93 ± 0.51
PO_3-P (mg L^{-1})	0.39–2.28	1.20 ± 0.57
NO_3-N (mg L^{-1})	0.10–1.05	0.492 ± 0.31
NO_2-N (mg L^{-1})	0.006–0.481	0.1570 ± 0.16

2.4. Harvest and restocki[illegible]

On day 120 of s[illegible]ocki[illegible] was d[illegible]ned out from each tank and harvested [illegible] prawns [illegible]ividu[illegible]ody weight, number of prawns from [illegible] tank was [illegible]. Percentage of BC, OC and SM male m[illegible]es were mea[illegible]ed at three treatments. The BC, OC and SM males w[illegible] segregated from all treatments into 3 tanks. After 1 [illegible]ek of harve[illegible] prawns were restocked at 5 prawn/m^2 ta[illegible] three treatme[illegible]s BC, OC and SM (also called treatments [illegible], R_{OC} and R_{SM}) respectively with three replicates per treatment. [illegible] day 80 of r[illegible]ocking all prawns were harvested and weighed.

2.5. [illegible]ty management

Water temperature and dissolved oxygen levels and pH ([illegible] Oxygen Meter, YSI Model 58, Yellow Springs, Ohio, USA) were measured daily. Nitrogen compounds (NH_3-N, NO_2-N, and NO_3-N) and orthophosphate (PO_4-P) analyses were performed bi-weekly using a digital HACH kit (model DR 2010, HACH Co., Loveland, USA).

2.6. Statistical analyses

For the statistical analysis of data, one-way analysis of variance (ANOVA) and Tukey's Test were performed using the SAS version-9.2 (Statistical Analysis System: SAS Institute, 1990). Significance was assigned at the 0.05% level. Specific growth rate (SGR) was estimated as: SGR = [Ln (final weight) − Ln (initial weight) × 100]/culture period (days). Survival rate of prawn was calculated as Survival (%) = (No. of harvested individual ÷ No. of stocked individual) × 100.

3. Results

During the all-male culture and isolation culture of BC, OC and SM, parameters of water quality were not significantly different ($P > 0.05$) among treatments. Data on mean values of water temperature, dissolved oxygen (DO), ammonia (NH_3-N), nitrite (NO_2-N), nitrate (NO_3-N) and orthophosphate (PO_4-P), and pH are presented in Table 1.

3.1. All-Male culture

Growth and yields performance results for prawns are presented in Table 2. Initial stocking weight of prawn was not significantly different ($P > 0.05$) among treatments whereas final harvested weight was the highest in the treatment R_{20} as compared to the R_{30} and R_{40}. Survival rate of freshwater prawn was