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Full Paper

Effect of culture season and stocking density on growth and production of giant freshwater prawn (*Macrobrachium rosenbergii* de Ma) raised in northern Thailand

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Abstract: This study evaluated the effects of culture season and stocking density on productivity of freshwater prawns that were raised in northern Thailand. The first experiment investigated the effect of climatic condition on the culture and production of freshwater prawn post larvae (PL 10; mean weight of 0.02 g) stocked in 400m^2 ponds. Results of the first experiment revealed that freshwater prawns raised during the dry season to summer had higher growth rate (0.19 g and 0.15 g/day) and survival rate (34.27% and 24.49%) than those raised during summer to rainy season ($p<0.05$). The second experiment investigated the effect of 2 different stocking densities (25 and 50 individuals/m^2) on the production survival of freshwater prawns. Results showed that the rate of growth, survival rate, and production were much higher at a stocking density of 25 individuals/m^2 ($p<0.05$) in contrast to 50 individuals/m^2.

Keywords: seasons, stocking density, freshwater prawn

Introduction

In recent years, aquaculture has been the fastest growing primary production industry worldwide, amounting to 39.4 million tons in 1998 [1]. The success of the industry is based on the selection of

species with adequate characteristics for commercial production. For example, an Australian redclaw crayfish species (*Cherax quadricarinatus*) is a species with considerable potential for commercial culture [2]. High growth and tolerance to wide variations in water quality parameters are important attributes, making the species suitable for cultivation [3].

Stocking density is a major factor affecting production parameters, such as growth, survival, and yield of culture species [4]. Several studies have been conducted to evaluate the effect of density on these production parameters in crayfish species. Lutz and Wolters [5], for example, developed model equations for prediction of pond harvest of red swamp crawfish (*Procambarus clarkii*) as a function of density. Jones and Ruscoe [6] conducted an experiment in earthen ponds to evaluate the effect of the stocking density (1, 3, and 5/m^2) on the production parameters for grow-out of red claw crayfish in Alabama. Morrisey [7] working with the same species in cages within the earthen ponds, determined stocking size (4.6-17.01 g) and density (3-15 individuals/m2) with optimum yields.

Pito and Rouse [8] proposed a management strategy for aquaculture in Ecuador, incorporating a mixed-sex nursery stage not exceeding 70-80 days, to obtain a minimum target size of 25 g. The individuals would subsequently be stocked at 6 individuals/m^2 for monosex grow-out for periods necessary to complete a 180-210 day cycle. In this study, an experiment was carried out using high stocking densities for the nursery stage to obtain the specified target size within 70-80 days and to evaluate the effect of those densities on survival and yields of the redclaw crayfish. Facilities of a commercial farm in gravel–lined ponds in Ecuador were used to conduct this investigation.

However, few researches about interactive effects of stocking density on prawn growth performance were reported. The experiment described here was conducted to determine the effect of culture season and stocking density on the growth, survival rate, and production of freshwater prawns (*Macrobrachium rosenbergii*).

Materials and methods

Experimental protocol

The study consisted of two experiments, in which the first evaluated of the effect of season on the growth and survival or production of freshwater prawns, while the second experiment evaluated the effect of stocking density on the same things. Two treatments (T1 and T2), each done in triplicate, were initiated in each experiment in a 400-m^2 experimental pond.

Experiment 1: Evaluation of the effect of culture season on the growth and production of freshwater prawns

The experiment was conducted from the dry season to summer (treatment 1) and the second phase was conducted from summer to rainy season (treatment 2). Mixed sexes (male and female) were stocked with post lavae (PL 10) with a mean weight of 5 g at a density of 25 PL/m^2 and cultured for a seven-month period (October 2004 to April 2005 and February 2006 to September 2006) for each trial. Commercial feeds (36% crude protein content) were fed (Table 1) four times daily (0800, 1000, 1200, and 1600 hr) from 0 to 90 days (at the rates of 30, 20, 12, 8.0, and 6.0 percent of the total biomass per

day) and three times daily from 91 to 210 days (at the rates of 4.0, 3.0, and 2.5 percent of the total biomass per day).

Table1. Feeding rate and feeding frequency

Age (day)	Feeding rate (%BW/day)	Feeding frequency (no.of time/day)
0-15	30	4
15-45	20	4
45-60	12	4
60-75	8.0	4
75-90	6.0	4
91-120	4.0	3
120-150	3.0	3
150 to harvest (210)	2.5	3

Experiment 2: Evaluation of the effect of stocking density in growth and production of freshwater prawns

Juvenile freshwater prawns were used. They were stocked into the experimental pond at 25 and 50 individuals/m^2 (T1 and T2 respectively). Commercial feeds (as above) were used and fed three times per day at an amount of 3 % of their total biomass/day.

Sample collection

The prawn sample was group-weighed (drained weight), counted, and returned to the pond. On the last sampling dates prior to harvest, prawns were also individually weighed.

Water quality management and monitoring

Water changes were made to all treatments at the same time. One-half volume of water was changed 3 times per week to maintain water quality. Aeration was contiunuous and DO concentrations were maintained to the experimental levels by control of aerating quantity. An on-site check for DO and temperature was done weekly (at 0900 hr) using a YSI Model 57 oxygen metre. Levels of total ammonia-nitrogen (TAN) and nitrite-nitrogen were determined weekly at approximately 0900 hr according to outlined procedures. The pH was determined weekly at 1300 hr using an electronic pH metre. Other variables measured (biweekly) were orthophosphate, nitrate, BOD, and turbidity. Data were compiled into monthly means for analysis.

Data analysis

Water quality data, prawn growth, survival rate, total production and feed conversion ration (FCR) data were analysed by Analysis of Variance (ANOVA) using SPSS 11.0 statistical software. Significant differences among the treatments were compared by Duncan's Multiple Range Test (DMRT). Differences were considered significant at the level of 0.05.

Results and Discussion

Experiment 1

There were no major differences in measured water quality parameters between treatments. Each variable was within an acceptable limit for freshwater prawn culture. Water temperatures in ponds ranged from a average of 25.2°C (for treatment 1) to 31.0°C (for treatment 2). Dissolved oxygen ranged from 6.1 to 7.4 mg/L (mean of 6.8mg/L) and pH was maintained at 8.0.

There were significant differences ($P<0.05$) in prawn growth and survival between treatments (Table 2). Based on the result of this study, prawns raised in dry season have higher survival rate (34.3% vs. 24.5%) and growth rate (0.19g/day vs. 0.15 g/day) as well as higher production (392 kg/rai vs. 208 kg/rai) compared to those raised in the rainy season, possibly because the abundance of natural food is much higher in the dry season than during the rainy season. Treatment 1 also resulted in statistically higher individual weights (47.8 ± 3.7 g) compared with those in treatment 2 (34.8 ± 1.7 g), although the feed conversion ratio in treatment 1 (2.43 $\pm$ 0.16) was slightly lower than that in treatment 2 (2.50 $\pm$ 0.83).

Table 2. Mean (±S.D.) harvest weight, production, survival, growth, and feed conversion ratio (FCR) of prawns cultured in ponds for 104 days after being stocked

	Treatment	
	T1 (Oct 2004-Apr.2005)	T2 (Feb 2006-Sep 2006)
Individual weight (g)	47.8 ± 3.7^{a}	34.8 ± 1.7^{a}
Total production (kg/rai*)	392.7 ± 27.2^{a}	208.27 ± 83.0^{a}
Survival rate (%)	34.3 ± 3.9^{a}	24.5 ± 13.1^{b}
Growth rate (g/day)	0.19 ± 0.01^{a}	0.15 ± 0.07^{b}
FCR	2.43 ± 0.16^{a}	2.50 ± 0.83^{a}

* 1 rai = 0.4 acre

N.B. Values are means of three replicates. Means within a row with different superscripts are significantly different ($P \leq 0.05$) by ANOVA.

The lives of crustaceans are affected by various environmental factors and therefore it is difficult to separate the effect of each factor. However, prawn growth seems to be strongly affected by temperature. Water temperature significantly effects the growth and metabolism of prawns. Temperature has an especially pronounced effect on feed consumption and growth. Feed consumption is optimal when water temperatures ranges from 27-31ºC. Feed consumption decreases both above and below this temperature range. However, results show that although the animal's initial body weight had a close linear relationship with food consumption and growth, and oxygen and food consumption and growth increased with temperature, temperature showed no effect on growth efficiency. Average temperature in treatment 1 (25.2˚C) was much lower compared to treatment 2 (31.0˚C). It has also been reported that the total yield of prawns increases with decreasing temperature [9,10].

Experiment 2

There were no major differences in measured water quality parameters for the two treatments. All the measured variables were within acceptable limits for freshwater prawn culture. In this study, water temperature ranged from 23.8° C to 28.3° C. Dissolved oxygen ranged from 6.7 to 7.4 mg/L (mean of 7.1 mg/L) and pH varied from 7.5 to 8.5 (mean of 8.0).

There were significant differences ($P<0.05$) in results obtained for the two treatments (Table 3). Final mean weight (34.8 $\pm$ 1.7 g), average weight gain (0.19 ± 0.01 g/day), total biomass (392 kg), and survival (34.3%) were all much higher for T1 (25 prawns/m^2) than those for T2 (50 prawn/m^2), regardless of individual sizes.

Table 3. Mean (± S.E.) harvest weight, production, survival, growth rate, and feed conversion ratio (FCR), of prawns cultured in ponds for 104 days after being stocked

	T1 (25 prawns/m^2)	T2 (50 prawns/m^2)
Individual weight (g)	34.8 ± 1.7^a	13.6 ± 2.2^b
Total production (kg)	392.7 ± 27.22^a	340 ± 91.7^b
Survival rate (%)	34.3^a	11.9^b
Growth rate (g/day)	0.19 ± 0.01^a	0.09 ± 0.01^b
FCR	2.43^a	2.53^a

N.B. Values are means of three replicates. Means within a row with different superscripts are significantly different ($P\leq0.05$) by ANOVA.

Thus, it is clear that density affects growth and production of freshwater prawns and that prawns are negatively affected by inadequate space. For giant freshwater prawns to grow properly certain optimal space is required, and high stocking density does not give a positive impact in the production of giant freshwater prawns.

Conclusion

Raising of freshwater prawns during dry season to summer and at lower stocking density resulted in superior growth of freshwater prawns.

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