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

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ABSTRACT

This study evaluated the effects of culture season and different stocking density on productivity of freshwater prawn that was raised in northern Thailand. The experiment was conducted at the Faculty of Fisheries technology and Aquatic resources, Maejo University, Chiang Mai, Thailand. This study was divided into two experiments; each treatment was replicated three times. First experiment investigated the effect of climatic condition on the culture and production of freshwater prawn Post larval (PL 10) prawns were used, with an initial mean weight of 0.02 g, were stock in 400m^2 ponds. Result of the first experiment revealed that freshwater prawn raised in dry season to summer obtained higher growth rate (0.19g and 0.15g/day) and survival rate (34.27% and 24.49%) than that of summer to rainy season ($p<0.05$). The second experiment investigated the effect of 2 different socking densities (25 and 50 individuals/m^2) on the production survival of freshwater prawn. Result showed that the rate of growth, survival rate and productions were much higher at the stocking density of 25 individuals/m^2 ($p<0.05$) in contrast to 50 individuals/m^2. Growth performances of freshwater prawns were triggered by stocking density and season.

Keywords; seasons, stocking density and freshwater prawn

Introduction

Production of the freshwater prawn *Macrobrachium rosenbergii* has increased substantially in recent years. These increases are partially based on several positive production attributes which include resistance to the diseases which have severely impacted penaeid production [Wang et al., 1998], the potential of producing large average sizes [New, 2000a and New, 2000b], and the recognition that prawn culture may be more environmentally sustainable than intensive penaeid shrimp production [Tidwell and D'Abramo, 2000]. Though prawn production has greatly increased, it continues to lag behind the rapid growth of the penaeid industry. This is partially due to the lower production rates (kg ha^{-1}) of prawns compared to most penaeid shrimps. However, these lower

production rates are also likely a positive factor in the environmental sustainability of prawn production.

In recent years, technologies have been developed which allow the intensification of prawn production rates without sacrificing large average sizes or negatively impacting water quality. These technologies include adding substrate materials to the production ponds combined with increased stocking densities, [Tidwell and D'Abramo, 2000]. During the nursery period, a dominance hierarchy develops which negatively impacts the subsequent growth of a large proportion of the population.

Stocking density is another important factor in shrimp culture. It significant affects shrimp growth (Martin et al., 1998), survival (Ray and Chien, 1992) and yield, etc. (Allan and Maguire, 1992 and Daniels et al., 1995). Few researches about interactive effects of stocking density on prawn growth performance were reported

This experiment described here was conducted to find out the effects of seasons and stocking density on the growth and survival rate of freshwater prawn. The aim was to determine the effects of stoking density and culture season on the growth and production of freshwater prawn (*M.rosenbergii*).

Materials and methods

1. Experimental protocol

The study had two components, first part evaluated of the effects of season on the growth, survival and production of freshwater prawn (*Macrobrachium rosenbergii*) and the second component determined the effects of stocking density on the survival growth and productivity of freshwater prawn. Two treatments were initiated in each experiment replicated three times in its equal size of experimental ponds.

2. Experiment number 1: Evaluated the effect culture season on the growth and production of freshwater prawn.

First trial was conducted during the dry season to summer and the second phase was conducted in summer to rainy season. Mixed sexes (male and female) were used in the study; it was raised with in a period of six months (Oct 04-Apr 05 and Feb 06-Sept 06) for each trial. Study had two treatments and replicated three times. Commercial feeds was used (36% CP content), experimental animal was fed four times for the period of 90 days at different feeding rates (30, 20, 12, 8.0, 6.0 percent of the total biomass) and fed three times per day during its 91 to 210 days (4.0,

3.0 and 2.5 percent of the total biomass). Feeding schedule was as follows: 8:00 am; 10:00 am: 12:00 noon 4:00 in the afternoon. Post larvae were used in the study (PL 10) with an average weight of 5g.

3. Experiment number 2: Evaluated the effect of two different stocking densities in growth and production of freshwater prawn.

Juvenile freshwater prawn was used; it was stocked into the experimental pond at different stocking densities. (25/m^2,vs 50 individuals /m^2). Commercial feeds was used and fed three times per day at the rate of 3 % of their total biomass/day.

4. Experimental procedure and sample collection

Water samples were analyzed every two weeks. Physical and biological parameters was measured including nitrite, nitrate, and also the althophosphate, dissolved, oxygen, pH and ammonia, biological oxygen demand, temperature, and turbidity were measured in situ. The sample was group-weighed (drained weight) counted, and returned to the pond. On the last sample dates prior to harvest, prawns were also individually weighed. These studies were conducted in 400 square meter pond. Both experiments had two treatments replicated three times. First study was emphasized on the effect of culture season (cool, dry season and rainy season). Second study evaluated the effect of stocking density (25individuals/m^2 and 50 individuals /m^2).

5. Experimental preparation and rearing management

Water exchanges were made to all the treatments at the same time, and one-half of the water (by volume) was exchanged 3 times per week to maintain water quality, pure oxygen and air were used to provide DO, and aeration was continuous. DO, concentrations was maintained to the experimental levels by control aerating quantity, and immovably tested it weekly (9:00am). Commercial food was used 36% crude protein

6. Water quality management

Dissolved oxygen (DO) and temperature of all ponds were monitored weekly (900 am) using a YSI Model 57 oxygen meter Levels of total ammonia–nitrogen (TAN) and nitrite–nitrogen were determined weekly from water samples collected from each pond at approximately 9:00 am according to outlined procedures. The pH was determined weekly at 1300 h using an electronic pH meter Sample data were compiled into monthly pond means for analysis.

7. Feed Tables

Feed tables have been developed that give a recommended feed rate expressed as percent of the body weight per day (%BW/Day), for animals of different sizes. As a general rule,

small animal are fed at higher percentage of their bodyweight per day than the large animals. This is because small animals will generally have higher metabolic rate than large animals.

Age (day)	(%BW/day)	Feed rate
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

8. Data analysis

Water quality data, shrimp growth, survival rate, total production and FCR data were analyzed by two-way ANOVA using SPSS 11.0 statistical software. Significant differences among the treatments were compared by LSD test. Differences were considered significant at the level of 0.05.

Results

Experiment 1

There were no major differences in measured water quality parameters between treatments. All the measured variables were within acceptable limits for freshwater prawn culture. Water temperatures in ponds ranged from25.16°C to 30.97°C. Dissolved oxygen ranged from 6.13 to 7.41 mg/L (mean of 6.77mg/l) and pH varied from 8.04 to 8.09 (mean of 8.06). There were significant differences (P<0.05) in prawn growth and survival between treatments (Table1). Final mean weight and average weight gain were significantly different, whereas total biomass increase was significantly higher in treatment 1 (392.67±27.23) than those of treatment 2. (208.27±82.99 kilos) Survival was significantly higher at treatment1 (34.27%) than treatment 2 (24.49%)

Table1. Mean (±S.E.) harvest weight, production, survival, feed conversion ratio (FCR), of prawns cultured in ponds for 104 days after being stocked

Variables	treatment	
	T1 (Oct 2004-April 2005)	T2 (Feb 2006-Sept 2006)
Individual weight (g)	34.85±1.73[a]	47.76±3.73[a]
Total production(kl)	392.67±27.23[a]	208.27±82.99[a]
Survival rate (%)	34.27±3.89[a]	24.49±13.13[b]
Growth rate (g)	0.19±0.01[a]	0.15±0.07[b]
FCR	2.43±0.16[a]	2.50±0.83[a]

Values are mean's of three replicates. Treatment means within a row followed by a different letter are significantly different ($P<0.05$) by ANOVA.

The production of freshwater prawns can influence by several factors climatic conditions (temperature, weather conditions and water quality), the season of the year and the quality of feeds that being used in the production aspect. In the recent study prawns might be affected by climatic changes. Result showed that the husbandry or production of freshwater prawn might be affected by season, its either cold season, rainy season or summer time. Season would also trigger the growth and survival of freshwater prawns. Based on the result of this study revealed that prawns raised in dry season had the highest survival rate (34.27%) and growth rate (0.19g/day) as well as production rate (392 kg/rai) compared to those raised in the rainy season (24.49%, 0.15g/day, 208.2 kg/rai).

The average individual weight is highly comparable Treatment 1 obtained a higher individual weights (47.76±3.73) compared with treatment 2 (34.85±1.72) (figure 1). Statistically revealed that there was a significant difference among treatments ($P<0.05$). The average percentage survival of prawns in Oct-April 2006 was higher in contrast to Feb-Sept 2006 (table1). Production was also higher during dry season Climatic condition is obviously affecting the pond condition. Prawn growth was strongly affected by temperature. Temperature is the major ecological factor influenced the growth and production of freshwater prawn

The feed conversion ratio was comparable during dry season, treatment 1 is slightly lower (2.43±0.02) than treatment 2 (2.53±0.83). Average temperature in treatment 1(25.16^{o}C) is much colder compared to treatment 2(30.97^{o}C).Effects of temperature on food consumption; growth and

oxygen consumption were estimated for the freshwater prawn (*Macrobrachium rosenbergii*) post larvae. The results showed that the animal's initial body weight had a close linear relationship with food consumption and growth. Food consumption increased directly with temperature. Growth increased significantly with increased temperature. However, temperature showed no effect on growth efficiency. Oxygen consumption increased significantly with temperature.

Experiment 2

There were no major differences in measured water quality parameters between treatments. All the measured variables were within acceptable limits for freshwater prawn culture. In the second study, water temperatures ranged from 23.8°C to 28.31.0°C. Dissolved oxygen ranged from 6.74 to 7.38 mg/l (mean of 7.06 mg/L) and pH varied from 7.5 to 8.5 (mean of 8.0).

Table2. Mean (±S.E.) harvest weight, production, survival, feed conversion ratio (FCR), of prawns cultured in ponds for 104 days after being stocked

Variables	Treatment	
	T1 (25individual/m^2)	T2 (50 individual/m^2)
Individual weight (g)	34.85±1.73[a]	13.60±2.15[b]
Total production (kg)	392.67±27.22 [a]	340±91.67[b]
Survival rate (%)	34.27[a]	11.89[b]
Growth rate (g)	0.19±.0.01[a]	0.09±0.01[b]
FCR	2.43[a]	2.53[a]

Values are mean's of three replicates. Treatment means within a row followed by a different letter are significantly different (P 0.05) by ANOVA.

There were significant differences (P<0.05) in prawn growth and survival between the densities tested between treatments (Table2). Final mean weight (34.85±1.73g) and average weight (0.19±0.01g) gain were significantly higher in treatment 1 (25prawns/m^2), and total biomass (392 kg) was significantly higher in treatment 1 with density of 25 individuals/ m^2 than that of treatment 2 (340 kg). Survival was significantly (34.27 percent) higher at the density of 25 prawns/m^2 than 50 individuals/m^2.

Based on the result of recent study it was indicated that the space requirement of giant freshwater prawn during the growing time was necessarily implemented. The adequate space had

a direct relation to the growth and production of freshwater prawn. As shown in the figure 10 the daily gained in weight of prawns in treatment 1was significantly higher (0.19±0.01g) compared to treatment 2 (0.09±0.01g).It was found out that the high stocking density (50prawns/m^2) doesn't give a positive impact in the production of giant freshwater prawn. Furthermore, at 25prawns/m^2 gave a higher production of 392 kilos regardless of individual size compared to 50prawns/m^2 (340 kg). Survival rate was also affected at 50prawns/m^2. (34.27% and 11.89%). All the necessary parameters were significantly favor at 25 prawns /$m^{2.}$

Discussion

Temperature is one of the most important a biotic factors affecting both growth and survival of crustaceans. It acts on metabolic processes and energy utilization freshwater prawns are stenothermal animals living between minimum temperatures. (Tidwell et. al1996) Level of 15°C and a maximum of 35°C rising of freshwater prawn *Macrobrachium rosenbergii* would be more advantageous during dry season because the abundance of natural food is much higher compared with rainy season. Temperature was less fluctuated. Survival and growth rate were much higher. The lives of crustaceans are affected by various environmental factors and therefore it is difficult to separate the effect of each factor. Thus, although water temperature has significantly effects the growth and metabolism of prawns. Temperature has a specially pronounced effect on feed consumption and growth, feed consumption is optimal when water temperatures are between 27ºC and 31ºC. Feed consumption decreases both above and below these temperatures (Tidwell et., al1996). Final individual weight showed a drastic increase (76.9%) with increased in temperature level from 30.97ºC (47.76g) but the total yield also had a sharp rise with the decreased in temperature (D'Abramo et.,al).

Greater survival rates at lower densities, was observed in the recent experiments. Survival of prawns cultured in ponds during 180 days (treatment2) it was affected by increasing densities (Sagi, A., Z. Ra'anan, D. Cohen and Y.Wax. 1986) and lower individual mean weights was observed This might be affected by inadequate space which needed by prawns to grow and space competition was also another reason wherein the survival was affected. However, in treatment 1 with lower stocking density at 25prawns /m^2 obtained a higher survival rate, growth rate and total production. An important requisite in this case seems to be stocked at optimum stocking density. The results observed here that the growth of prawns was directly related to the stocking density per square meter. It was observed that a stocking density of 25 PLs/m^2 provided better growth than 50

PL's/m^2; final biomass was highest at the least stocking density. Moreover, greater survival rate at lower densities, which was observed in the study.

These data suggest that stocking post-larvae in pond at high densities, (50 PLs/m^2) can't be a good strategy to increased production, seems to be appropriate to introduced additional substrate to increase a surface area needed by prawns to grow.

Conclusion

1. The present study demonstrated the advantage of stocking density when growing *M. rosenbergii* in earthen ponds. At lower stocking density attain a good growth of freshwater prawn.
2. Raising of freshwater prawn during dry season to summer resulted in superior of prawns growth.

Recommendations

Growing of *M.rosenbergii* at lower stocking density during dry season to summer time attain a good growth and survival and production. Further research will be recommended to be proved the significant effect of culture season on the growth of freshwater prawn.

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