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Stocking density, Survival rate and Growth performance of *Litopenaeus vannamei* - (Boon, 1931) in different cultured shrimp farms

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Abstract

The effect of stocking density, survival and growth performance of *Litopenaeus vannamei* was survived in four shrimp farms (RS, SPDS, Valliviles and Nanda settu aqua farms) at Vellar Estuary, Cuddalore District, Tamil Nadu, during the period of April 2014 -August 2014. The present investigation were stocked 100/m2 and one pond was stocked 12/m2 the results of water quality parameters was showed Temperature (27 to 32), pH (7.8 to 8.7), Dissolved oxygen (3 to 5.2 mgl-1), salinity (15 to 38psu), Ammonia (0.22 to 1.8 mgl-1). The survival rate 80 to 90 %, FCR 1: 1.39 to 1: 1.4, Average body weight 20 to 34 gms and the total production was recorded (3200 to 4689kg). In the present study was concluded that, good water quality parameter play a crucial role in shrimp culture ponds especially the low salinity (15-38psu) which was optimum for shrimp culture ponds. The high hector level ponds were used to highly survival rate in low stacking of the shrimps were abundance growth.

Keywords: Survival, Post- Larvae, Growth, *L. vannamei*

Introduction

Aquaculture production has grown tremendously in past two decades and is expected to continue during the next few years, were The world production of shrimp increased 250 folds during the last 35 years from 10,000 ton in 1970 to 2, 461, 000 tones in 2005 (FAO, 2002) Currently, the states with largest shrimp aquaculture are Sonora (62%) and Sinaloa (29%). its annual production researched almost 5 million tons in 2006 (FAO). *Litopenaeus vannamei* is the most important *penaeid* shrimp species farmed earth (Alcivar- Warren *et al.,* 2007). is the most widely cultured shrimp in the western hemisphere were the species contributes to regarding 90% of the total shrimp culture (Wurmann *et al.,* 2004) the most commonly cultured shrimp and central and south American countries, China and Thailand (Frias-Espricueta *et al.,* 2001; MC Graw *et al.,* 2002). Due to the economic importance of *penaeid* shrimp world wide, particularly in aquaculture, a huge attempt to know the enlargement ecology of *Penaeus spp.* has been made in recent years.

Total production of *Litopenaeus vannamei* in Asian was approximately 31600 mt in 2002 in some countries India rank second next to china in shrimp making. India has the one of the highest line of 8118 km. The shrimp culture commercially the most important form as much as 90 percent of the total

landing. *L. vannamei*, are presently being grown in low-salinity inland waters experimentally and commercially in Alabama, Arizona, Florida, Indiana, Illinois and Texas (Samocha *et al.*, 2002). Here shrimp farming, increase and production of shrimp species are depend on the population density (Sugathan *et al.*,2014) production of the shrimp on a wide range of factors, the most important being the stocking density which influences the growth and survival rates of the stock. The optimal stocking density varies depending on the farm system and organization practices. In India the fabrication of *L.vannamei* culture about 18247 (MT) from 2930 ha culture in 2010-2011, the production of shrimp 48430.00 (MT).Because of the reduced risk of catastrophic diseases and favorable environmental conations.

This includes studies on the influence of environmental factors such as temperature (Wyban *et al*., 1995; Miao and Tu, 1996; Ye *et al.,* 2003; López-Martínez *et al.,* 2003), salinity (Lemos *et al.,* 2001) on shrimp growth. Shrimp farming is one of the majority gainful and fast-growing segments of the aquaculture industry (Tacon, 2002). Unfortunately, this manufacturing has suffered drastic collapses from decrease growth and survival as an increase in stocking density. Reduced growth and continued existence of shrimp refined at high density is thought to result from combination of factors, which comprise a decrease of positive space and usual food sources, an increase in adverse shrimp behavior such as cannibalism, a humiliation of water quality and an buildup of unwanted sediment (Kautsky *et al.,* 2000; Arnold *et al.,* 2006). States that shrimp natural habitats have temperature over 20°C throughout the year so these temperatures are good for growth. Walker *et al*., (2009) analyzed the consequence of salinity on growth rate at temperatures near 28°C finding no significant variation in growth rate at level of 10 and 28ppt. Teichert Coddington and Rodriguez, (1995). When the post-larvae are grown in the hatchery till the juvenile stage and thereafter stocked in ponds, the survival rates could be expected to enhance compared to a system where the post-larvae are directly stocked in ponds (AQUACOP, 1984).

Several authors described concerning the growth in shrimp culture systems based on stocking density (Cailout *et al.,* 1976; Sedgwick 1979; Maguire and Leedow 1983) and some authors include reported an inverse relationship between growth and stocking density (Lee *et al.,* 1986; Sandifer *et al.,* 1987; Daniels *et al.,* 1995). The objective of this work was to evaluate the water quality parameters, survival, growth and FCR rate of *L. vannamei* cultures in the different aquaculture shrimp farms with different stocking densities and different hector levels.

Materials and Methods

The present study was under taken at a four different aquaculture shrimp farms (RS, SPDS, Valli viles and Nanda Settu) aquaculture shrimp farms at Vellar estuary, Cuddalore district, Tamil Nadu, during the study period of (April 2014 - August 2014). Ponds were pumped with vellar estuary water; all the culture ponds were (1.2- 1.5m deep) three ponds are 0.4ha area and Nanda Settu aqua farm is 0.8ha the study was conducted in each farm one culture ponds. The minimum water level in each pond was 5cm daily water pump were of 5 to15% and just the once a week, the pond shape is rectangular, the *L. vannamei* seeds post- larval stage 15 that had been acclimated to a salinity level of 35ppt and confirmed negative for the white spot syndrome virus (WSSV) by the polymerase chain reaction were purchased fro BMR hatchery (Hybrid) Marakkanam, Villupuram district, Tamil Nadu. Cost of seed Rs.50 paisa for each water depth maintained 8ft. The seed were transported in oxygenated double- covered polythene bags with compressed ice packs between inner and outer covers of the bags to maintain optimum temperature in turn to keep less stress to the shrimp and the entire set up was packed in a carton. The seed were bring to the farm site and bags were reserved in the pond water for some time to adjust the temperature.

Then pond water was added gradually into the seed bag to regulate the salinity and pH subsequently the seed were released slowly in to the ponds each water depth maintained 8ft. in the summer season *L. vannamei* post larvae stocking densities were, taken for culture in four ponds three ponds were 200000/species and another pond 150000/species and also survival was, 80, 85.5, 84 and 90% respectively. Blanca feed pellets (CP -Aquaculture India Pvt Ltd) was fed to the stocked post larvae for four times, daily at 6am 10 am 2 pm and 6 pm respectively. Paddle wheel aerators were used and check trays were maintained for 120 days of culture, from the 30th days culture (DOC) every ten days one time shrimps were collected through the cast net (sampling) which was to monitoring shrimp heath and growth. The water level was measured by using a standard scale with cm marking.

Water quality parameters

The Physical- chemical parameters such as Temperature, pH, Dissolved Oxygen, Salinity and Ammonia were measured daily at morning 6am analyzed at weekly intervals. Temperature ºC were measured thermometer, salinity was measured by using hand refractometer (Erma, Japan) the pH of the water by using a calibrate pH pen (pH esp. - 3 model) the dissolved oxygen was measured by modified Winkler's method described by Strickland and Parson (1972) and ammonia was analyzed by using standard method described by (Solorzano 1969 and Koroleff 1969) growth and water quality parameters were statistically analyzed.

Growth performance

Growth performance of shrimp were measured based on mean individual weight at harvest, total weight gain, growth rate, feed conversion ration (FCR) and survival rate, total weight gain, growth rate, FCR and survival rate were calculate by the formula.

Total weight (g) = sum of individual weight (g)

Total weight gain (wet weight g) = Final total weight – initial total weight.

Growth rate (g day $^{-1}$) = final wet weight – initial wet weight)/ days of culture

$$\text{FCR} = \frac{\text{Total feed (g)}}{\text{Total wet weight gain (g)}}$$

$$\text{Survival rate (\%)} = \frac{\text{Number at harvest} \times 100}{}$$

Results

The present study reported the optimum water quality parameters for maintain suitable culture temperature, pH, dissolved oxygen, salinity and ammonia were 25-27 ºC ,7.5-7.9,1.3-2.6 mgl^{-1}, 15-25ppt and 0.1-0.18 mgl^{-1} respectively in Nanda settu aqua farms. Growth rate of the shrimp was showed significant differences among the various density ponds. The different culture days and average weights of the shrimp were observed in all culture ponds, are respectively in Table -2. Respect to survival rates, they were between, 80 to 90% with maximum survival was recorded in p4 and minimum was recorded in P1it Table -3. Presented in Salinity values was ranged between 15 to 25psu which were ideal for the improve of shrimps as recorded at P4 and the mean weight is 20.00, 22.00, 21.15, and 34.00g were as P1, P2, P3, and P4 respectively (Table-3). Survival rates were as, 80 to 90%. The given feed was 4480, 5320, 5003, and 6564kg for 120 days. Total count (number/kg) recorded is 29.4 to 50, show in Table 3. FCR was 1.4, 1.4, 1.39, and 1.3 were as P1, P2, P3, and P4 respectively. Total shrimp harvest (kg) was recorded as 3200, 3800, 3574, and 4689kg for 120days respectively cost of the species at harvesting time 30 counts (numbers/Kg) were cost Rs, 400/kg, They are increasing counts some times (numbers/kg) such as 40, 41, 42, it decreased the amount of market values because of their body weight.

Table – 1: Water quality parameters

Parameters	RS (P1)	SPDS (P2)	Valli viles (P3)	Nanda Settu (P4)
Salinity(psu)	26-33	27-28	25-33	25-27
Temperature ºC	35-38	30-33	30-34	15-25
pH	8-8.5	7.9-8.4	7.8-8.0	7.5-7.9
DO (Mgl-$^{1)}$	2-5.0	3.1-5.2	1.3-3.3	1.7-2.6
Ammonia(Mgl-^{1})	0.12-0.36	0.1-0.3	0.13-0.2	0.1-0.18

Table – 2: Days of culture and growth performance

Days of culture	RS(P1)	SPDS(P2)	Valli viles(P3)	Nanda Settu(P4)
30	4.0	5.00	5.35	6.00
40	6.58	8.40	7.50	9.00
50	8.90	10.60	9.23	14.00
60	11.00	12.40	11.20	19.00
70	13.00	14.00	13.20	23.10
80	14.70	16.00	14.80	26.20
90	16.10	18.20	16.80	28.00
100	18.00	19.10	18.90	30.20
110	19.00	20.75	20.00	32.20
120	20.00	22.00	21.00	34.00

Table -3: Pond performance details

Details	Aquaculture shrimp farms			
	RS(P1)	SPDS(P2)	Valli viles(P3)	Nanda Settu(P4)
Area (Ha)	0.4	0.4	0.4	0.8
Initial stocking(Numbers)	200000	200000	200000	150000
Stocking Date	29.04.2014	29.04.2014	29.04.2014	29.04.2014
PL stocking days	PL15	PL15	PL15	PL15
Harvest date	26.08.2014	26.08.2014	26.08.2014	26.08.2014
Harvest size (g)	20.00	22.00	21.15	34.00
Count (numbers/Kg)	50	45	47	29.4
Shrimp harvest (Kg)	3200	3800	3574	4689
Survival (%)& Number	80-160000	85.5-1710000	84-168000	90-136000
Total feed used (Kg)	4480	5320	5003	6564
FCR	1.4	1.4	1.39	1.3

Discussion

Shrimp farming is an aquaculture business industry in many developing countries for earning foreign trade and providing service to the coastal people (Sugathan *et at.,* 2014). The physical parameters of water play vital role in the culture systems maintenance of water quality was essential for optimum growth and survival of shrimp excess feed, fecal matter and metabolites will exert tremendous influence on the water quality of shrimp farm (Soundarapandian and Gunalan, 2008). Shrimp farming one of the most profitable and fast growing segment of the aquaculture industry (Tacon, 2002). Analyzed the effect of salinity on growth rate at temperatures near 28 ºC finding no significant difference in growth rate at level of 10 and 25 ppt. (Teichert coddington and Rodriquez 1995) despite the growth difference experiential all values of the parameters meet the water quality requirements for shrimp production (Cawthorne *et al.,* 1983; Allan and Maguire 1991; Garcia and Brune, 1991: Lee and Wickins, 1992). Karthikean, 1994 and Kunalan *et al,* 2010, reported the good growth and survival of *L. vannamei* in brackish water ponds of 10 to 35ppt which be ideal for shrimp culture. Though the shrimp tolerate the salinity was recorded 2.45ppt (Paraker *et al.,* 1974). In the present study the salinity was maintain at 15to 38ppt. The study shows that stocking density influencing the growth and survival of *L. vannamei* in the shrimp farms located in the vellar estuary in Cuddalore district Tamil Nadu south east coast of India.

Several authors have reported on the growth and survival of *L. vannamei* stocked in different salinity and densities in culture ponds (Wyban *et al.*, 1998; Samocha *et al.*, 1993; Samocha, 1999). Wang et al 2004 reported that favorable pH form 7.6- 8.6 for *L. vannamei* and it was observed at a (7.0-7.9). (Fast and Lannan 1992), stated most excellent shrimp growth was experiential in a temperature ranged from 24-32^{o}C during the culture period the temperature was recorded between 25-30^{o}C. Early morning dissolved oxygen concentration was ranged between 3.0 and 4.5 Mgl-^{1} salinity was about 14% during the first week of growing out pond which is preferable for post larvae (PL).

The initial lower temperature would include summary metabolism and diet intake of the shrimp (Lester and Pante 1992) investigated at an expected 8 shrimp survival density, reduction of the levels of the diets recommended by manufacturers in 50 and 75%; the best feed conversion rate was obtained with a 30 %protein diet reduced to 50% (Nunes *et al.*, 2006) tested the effect of temporal feeding no main difference in final body weight with rate restricted feeding up to 50% (Esparza- Leal *et al*., 2010). The growth rate of pacific white shrimp is improved than other farmed shrimp species and can grow up to 3gr/week and reach up to 20gr under intensive culture conditions (FAO, 2004).

The stocking density of this species is very high and it is possible stocking of up to 150/m^2 in pond culture and even as high as 400/m^2 in controlled re circulated tank culture (FAO, 2004). More than a few authors have reported on the growth and survival of *L. vannamei* stock in different salinity and densities in culture ponds (Wyban *et al.*, 1998; Samocha *et al.*, 1993; Samocha *et al.*, 1999). The best final average body weight gained from the Nanda settu aqua farms 34.0g so always minimum or optimum stocking density plays a major role the better growth of *L. vannamei*. Finally our study revealed that the maximum production was obtained in pond with low stocking densities of high survival rates and low salinity. An inverse relationship is known to exist between the stocking density and the survival and growth rates (Sandifer and Smith 1976, Emmerson and Andrews 1981). Several authors described about the growth in shrimp culture systems based on stocking density (Cailout *et al.*, 1976; Sedgwick 1979; Maguire and Leedow 1983). In the present study was concluded that, good water quality parameter play a crucial role in shrimp culture ponds especially the low salinity (15-38psu) which was optimum for shrimp culture ponds. The high hector level ponds were used to highly survival rate in low stacking of the shrimps were abundance growth.

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