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Rameshu Katturi
Department of Zoology and Aquaculture, Acharya Nagarjuna University, Guntur, Andhra Pradesh, India

Lalitha Vinnakota
Department of Zoology and Aquaculture, Acharya Nagarjuna University, Guntur, Andhra Pradesh, India

V Venkata Rathnamma
Department of Zoology and Aquaculture, Acharya Nagarjuna University, Guntur, Andhra Pradesh, India

Corresponding Author:
Rameshu Katturi
Department of Zoology and Aquaculture, Acharya Nagarjuna University, Guntur, Andhra Pradesh, India

Comparative study on the survival and growth performance of white shrimp *Penaeus vannamei* in ponds cultured with hatchery and nursery reared post larvae

Rameshu Katturi, Lalitha Vinnakota and V Venkata Rathnamma

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Abstract
The enlargement of shrimp culture has been rapid in recent years. The present study was conducted during the year 2018 to estimate shrimp performance such as survival and growth rate of *P. vannamei* both in ponds cultured with hatchery reared and nursery reared post larvae in different seasonal crops. The ponds selected for this study are located at Yazali, in Guntur District of Andhra Pradesh. The maximum growth was recorded in grams as 38.17±0.47 and 36.26±0.51, 34.58±0.43 and 31.46±0.32 for both summer and winter crops at 120 days culture in nursery and hatchery reared ponds respectively. With regard to survival rate the maximum survival of 83.27 and 81.52 was recorded for both summer and winter crops respectively. The present data revealed that, the highest augmentation in survival and growth rate are recorded in the culture ponds of nursery reared post larvae than hatchery reared post larvae.

Keywords: Growth, survival and *P. vannamei*

1. Introduction
Shrimps are considered as universal diet; hence shrimp culture is one of significant foreign exchange earner through export. The culture of the American white shrimp enormously increased in India since last two decades. Farmers are actively involved in the culture operation of this species due to various reasons such as fast growth, adjust to low salinity levels and wide range of water fluctuations (Alcivar-Warren *et al.,* 2007) [2]. Currently in shrimp farming practices, *P. Vannamei* is most widely cultured species, due to its inherent capabilities like disease resistance, can sustain to higher temperature, adoptable to wide range of salinities and frequent water fluctuations. Soundarapandian *et al.,* (2010) [22] investigated the effect of probiotics on the growth and survival of *P. monodon.* Balakrishnan *et al.,* (2011) [4] reported the survival and growth rates of *P. vannamei* against various stocking densities' levels.
In most of aquaculture sectors brackish water preferred for the culture of penaeid shrimp species. Ravuru and Mude (2014) [12] revealed the growth of cultured white shrimp *P. vannamei* in brackish water culture system during summer season with artificial diet. Aalimahmoudi *et al.,* (2016) [1] studied about the feeding frequencies and their impacts on FCR (Food Conversion Ratios), growth and survival, and water quality parameters in *P. vannamei* cultured ponds. The purpose of the present study is to estimate the growth and survival rate of *P. vannamei* in ponds cultured with hatchery and nursery reared post larvae both in summer and winter seasons.

2. Material and Methods
The present study was conducted in commercial shrimp farms which are located at Yazali, Guntur District of Andhra Pradesh (15.9411°N 80.5466°E). To estimate the growth and survival of the shrimp a comparative study was conducted in two different rearing ponds, i.e. ponds stocked with nursery reared post larvae and ponds stocked with hatchery reared post-larvae. This study was conducted in two crops i.e. summer and winter crops during the year 2018.

2.1. Pond Preparation and Procedure of feeding methods

Initially the culture ponds of the current study were allowed to dry and crack to promote the capacity of the hydrogen sulphide and to eradicate the fish eggs and other predators. Then the pond bottom was thoroughly ploughed at a depth of 35 cm to remove the obnoxious gases existing in the soil. Ponds ready for culture operation after 21 days of time period. The healthy seeds were purchased from a local commercial hatchery and were stocked at a density of 13/m^2. In order to acclimatize the seeds to pond atmosphere seed bags were allowed to float on water surface in each pond for 35 minutes. After that the seed bags were slowly opened and released in to the pond water.

The shrimps were fed with CP feed (Charoen Pokhpond Aquaculture India Pvt. Ltd.). The feeding schedule was based on the feed chart given by the CP Company. Four check trays were installed in ponds and the feeding was adjusted based on the check tray observation and body weight sampling. The total feed used per day was monitored at the rate of 18%, 23%, 18%, 23% and 18% in the morning (6:00 AM), noon (10:00 AM), afternoon (2:00 PM), evening (6:00 PM) and night (10:00 PM) time respectively. For feed broadcasting the rope method was employed for the present study. Usually the water exchange was not practiced for the first 30 days, later on 15-18 cm of water was exchanged in ten days intervals. Sampling was done at regular intervals of time and the individual weights of the shrimps, survival rate and average body weight of the animals were estimated. The recorded values were tabulated.

The average body weight and survival rate of the shrimp was estimated by adopting the following formulae

Average Body Weight (ABW)

Weight gain (%) = (Final weight-Initial weight)/Initial weight x 100

Survival Rate

Survival (%) = Nos. of animals survived/Nos. of animals stocked x 100

2.2. Growth monitoring and sampling

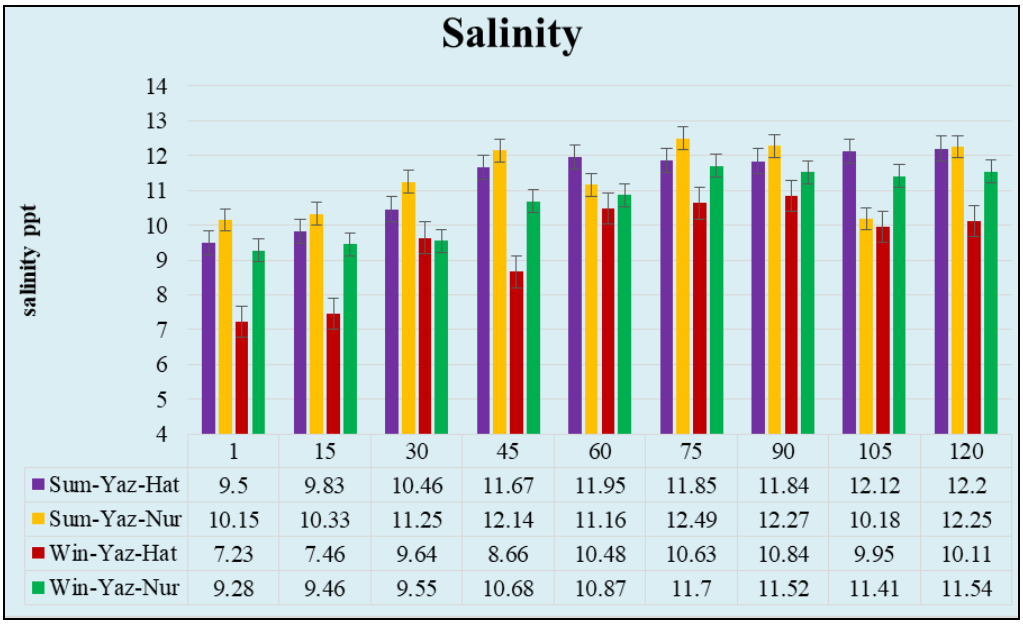
The growth of the shrimp in culture period was estimated by the process of sampling shrimps by cast net weekly. Periodically the live samples of the shrimps were measured to estimate the biomass of the shrimp population by using a 2 Kg plastic weighing balance made by Crystal Company with sensitivity of 100 gm. The health condition of the shrimps and comparative growth values were recorded in four ponds from two crops during the study period.

3. Results

3.1. Water quality parameters:

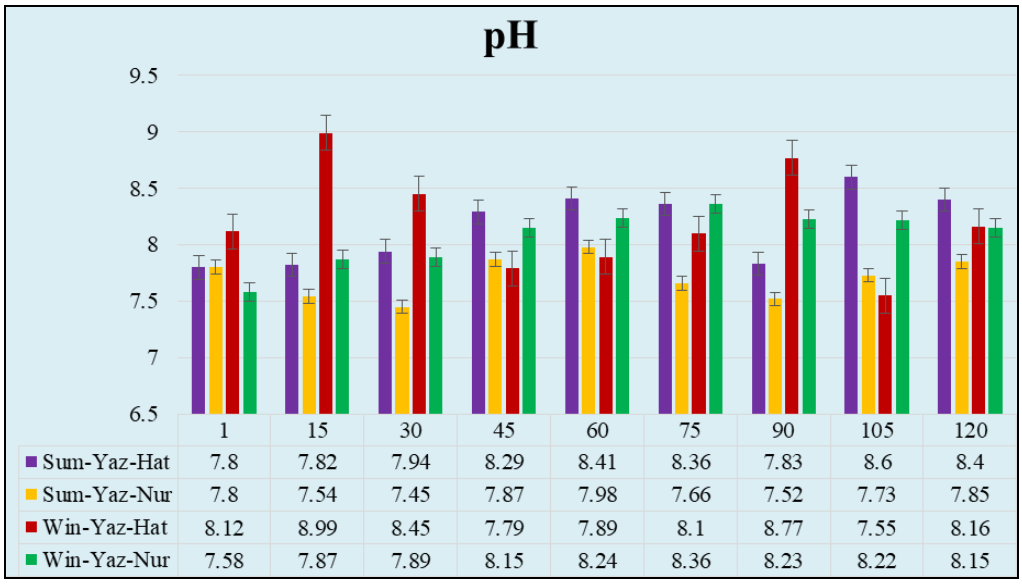
It is evident from the results of the summer crop of 2018 at Yazali for 120days, in the ponds, stocked with hatchery reared post larvae, the salinity of pond water ranged from 9.50 ± 1.5 to 12.20 ± 1.3 ppt and pH from 7.80 ± 1.2 to 8.60 ± 1.4. Water temperature varied from 28.43 ± 1.2 to 30.49 ± 1.7ºC; dissolved oxygen contents were varied from 4.76 ± 1.2 to 5.82 ± 1.5 mg/l. Whereas in the case of nursery reared ponds salinity values recorded from 10.15 ± 1.8 to 12.49 ± 1.5 ppt and pH was 7.45 ± 1.3 to 7.98 ± 1.1 respectively. Pond water temperature varied from 25.26 ± 1.5 to 29.25 ± 1.3 ºC and the dissolved oxygen was also recorded that is 4.15± 1.0 to 5.18±1.7 mg/l.

Similarly in winter crop in the ponds stocked with hatchery reared post larvae, the salinity of pond water ranged from 7.23 ± 1.5 to 10.84 ± 2.2 ppt and pH from 7.55 ± 1.6 to 8.99 ± 1.2. Temperature of the pond water ranged from 26.47 ± 1.2 to 28.75 ± 1.5ºC and dissolved oxygen varied from 4.44 ± 1.9 to 6.75 ± 1.2 mg/l. Whereas in the ponds stocked with nursery reared post larvae, the salinity of pond water ranged from 9.28 ± 1.2 to 11.70 ± 1.2 ppt and pH from 7.58 ± 1.3 to 8.36 ± 1.1, pond water temperature ranged from 25.26 ± 1.2 to 28.99 ± 1.2 ºC and dissolved oxygen contents were varied from 4.14 ± 1.7 to 5.45 ± 1.4 mg/l.



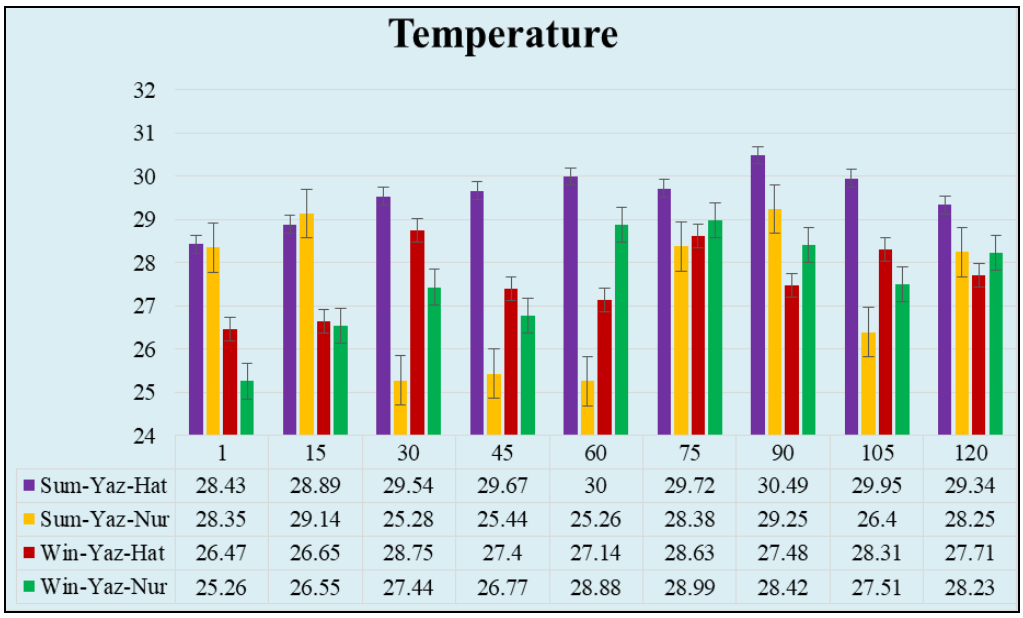
	1	15	30	45	60	75	90	105	120
Sum-Yaz-Hat	9.5	9.83	10.46	11.67	11.95	11.85	11.84	12.12	12.2
Sum-Yaz-Nur	10.15	10.33	11.25	12.14	11.16	12.49	12.27	10.18	12.25
Win-Yaz-Hat	7.23	7.46	9.64	8.66	10.48	10.63	10.84	9.95	10.11
Win-Yaz-Nur	9.28	9.46	9.55	10.68	10.87	11.7	11.52	11.41	11.54

Fig 1: Salinity of *P.Vannamei* culture at Yazali during the year 2018.



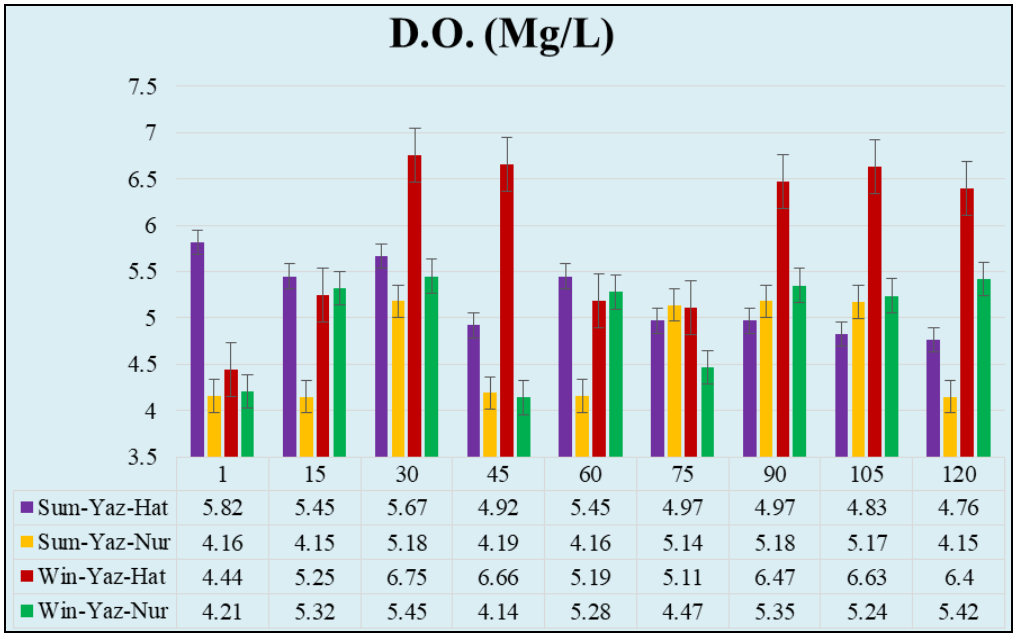
	1	15	30	45	60	75	90	105	120
Sum-Yaz-Hat	7.8	7.82	7.94	8.29	8.41	8.36	7.83	8.6	8.4
Sum-Yaz-Nur	7.8	7.54	7.45	7.87	7.98	7.66	7.52	7.73	7.85
Win-Yaz-Hat	8.12	8.99	8.45	7.79	7.89	8.1	8.77	7.55	8.16
Win-Yaz-Nur	7.58	7.87	7.89	8.15	8.24	8.36	8.23	8.22	8.15

Fig 2: pH of *P.Vannamei* culture in summer crop at Yazali during the year 2018.



	1	15	30	45	60	75	90	105	120
Sum-Yaz-Hat	28.43	28.89	29.54	29.67	30	29.72	30.49	29.95	29.34
Sum-Yaz-Nur	28.35	29.14	25.28	25.44	25.26	28.38	29.25	26.4	28.25
Win-Yaz-Hat	26.47	26.65	28.75	27.4	27.14	28.63	27.48	28.31	27.71
Win-Yaz-Nur	25.26	26.55	27.44	26.77	28.88	28.99	28.42	27.51	28.23

Fig 3: Temperature of *P.Vannamei* culture at Yazali during the year 2018.



	1	15	30	45	60	75	90	105	120
Sum-Yaz-Hat	5.82	5.45	5.67	4.92	5.45	4.97	4.97	4.83	4.76
Sum-Yaz-Nur	4.16	4.15	5.18	4.19	4.16	5.14	5.18	5.17	4.15
Win-Yaz-Hat	4.44	5.25	6.75	6.66	5.19	5.11	6.47	6.63	6.4
Win-Yaz-Nur	4.21	5.32	5.45	4.14	5.28	4.47	5.35	5.24	5.42

Fig 4: Dissolved Oxygen (D.O) of *P.Vannamei* culture at Yazali during the year 2018

3.2. Survival rate

In the present study the percentage survival rate was recorded in two different rearing ponds. For the summer crop in ponds stocked with hatchery reared post larvae the survival rate of 74.2% was observed and the percentage of 83.2% was recorded for the nursery reared post larvae. Whereas for the winter crop in ponds stocked with hatchery reared post larvae the survival rate of 65.8% was observed and the percentage of 81.5% was recorded for the nursery reared post larvae. Better performance of shrimp was recorded in summer crop. Statistical analyses were carried out at the end of the target period of the cultural crops. The data of percentage of survival are represented in the tabe. 1.

Table 1: Percentage of survival of *P.Vannamei* in different crops during the year 2018.

S/N	Summer crop		Winter crop	
	Direct Stocking of PL	In Pond Nursery of PL	Direct Stocking of PL	In Pond Nursery of PL
1	74.2%	83.2%	65.8%	81.5%

3.3. Growth rate

The growth in grams was recorded at 30 days of culture in summer crop for the pond stocked with hatchery reared post larvae as 3.80±0.23. Whereas the ponds stocked with nursery reared post larvae, the growth of shrimp was 3.49±0.27. Similarly the maximum growth rates of the larvae were noticed as 38.17±1.10 and 36.26±0.33 respectively for the ponds stocked with nursery and hatchery reared post larvae at 120days of culture (Figure 5). The growth in grams was recorded at 30 days of culture in winter crop for the pond stocked with hatchery reared post larvae as 3.45±0.23. Whereas the ponds stocked with nursery reared post larvae, the growth of shrimp was 2.65±0.17. Similarly the maximum growth rates of the larvae were noticed at 120 days of culture as 34.58±0.29 and 31.46±0.33 respectively for the ponds stocked with nursery and hatchery reared post larvae (Figure 6).

In the present study the ponds stocked with nursery reared post larvae of *P. Vannamei* has a high growth value and survival percentage when compared with the ponds stocked with hatchery reared post larvae in both crops. There were significant differences in both seasons.

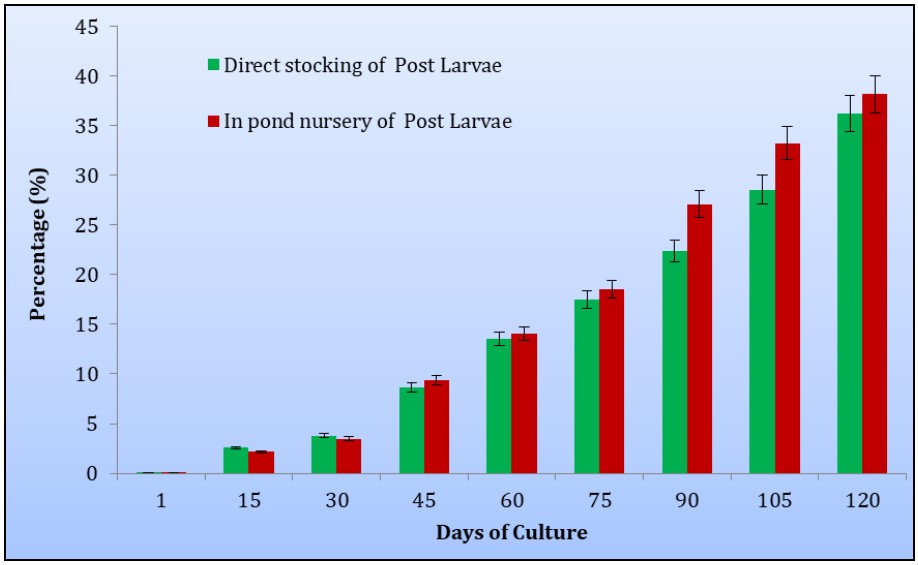


Fig 5: Growth of *P. vannamei* (in grams) at Yazali (Guntur) in summer crop during the year 2018.

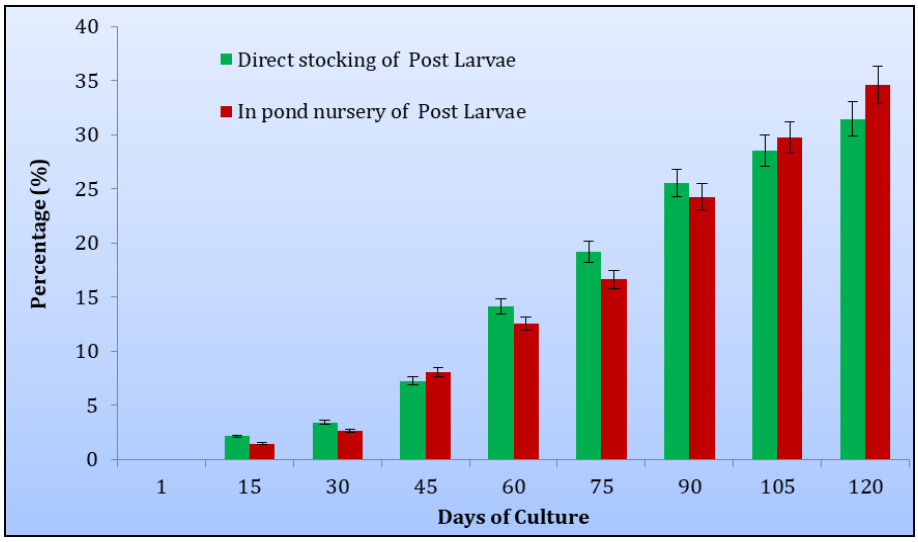


Fig 6: Growth of *P. vannamei* (in grams) at Yazali (Guntur) in winter crop during the year 2018

4. Discussion

The current study is reported on the water quality parameters, percentage of survival and growth rate in the culture of *P. vannamei* stocked with hatchery and nursery reared ponds in two different seasonal crops i.e. summer and winter. The quality of water in any pond ecosystem plays a significant role and shows their impact on growth and survival of organisms. So good quality of water is essential for shrimp culture and it is characterized by salinity, pH, temperature and dissolved oxygen. Soundarapandian and Gunalan (2008) [21] reported the quality of water in shrimp culture ponds depends on the feed, fecal matter and the percentage of metabolic wastes released during the culture process. Jamabo (2008) reported salinity is an important factor that influences the growth and density of the population of aquatic organisms. Shrimp species like *Litopenaeus setiferus* and *Farfantepenaeus aztecus* cannot tolerate salinity of less than 2 ppt (Keiser and Aldrich, 1976) [16]. An observation made by Mair (1980) among four shrimp species (*P. vannamei*, *P. stylirostris*, *P. californiensis* and *P. brevirostris) P. vannamei* can be best suited for low levels of water salinities. Paulraj and Sanjeevaraj (1982) [19] studied about the effects of various salinities on the growth and survival of the three Indian penaeid shrimps.

Maximum all penaeid shrimps can grow in a wide range of salinities. In the present study it was 7.23 to 12.49 ppt was noted and the highest salinity was recorded for summer seasons. So the results of present study revealed that survival and growth rate were increases with increase in salinities for 120 days. Studies of Cheng and Liao (1986) [10] reported that *P. monodon* is a candidate species to manage osmotic and ionic regulation effectively. It can be tolerate a salinity range between 0 to 60 ppt. Juveniles of *P. monodon* mostly euryhaline than adults. Salinity responses in the juveniles of *P. japonicus* were studied by Dalla Via (1986) [11]. Juveniles of *P. vannamei* have been successfully cultured at salinity ranged from 5 to 35 ppt and many shrimp species belongs to penaeid shrimp were euryhaline (Sturmer and Lawrence, 1989; Bray *et al.*, 1994; Ponce-Palafox *et al.*, 1997) [20].

According to Balakrishnan *et al.*, (2011) [4] the percentage wise survival of 80-92% was observed in *P. vannamei* culture at a pH range of 7.9-9.1. In the present study the pH concentration was found to be varied from 7.45 to 8.99. The optimum pH range for shrimp cultivation is 7.3 to 8.5 and tolerance range is 6.5 to 9 (Suprapto, 2005) [24]. In culture ponds of *P. monodon*, the pH of 3.7 is considered as minimum lethal pH at a water salinity of 32 ppt and 5.0 is the optimum pH as recommended by Allan and Maguire (1992) [3]. According to Bhatnagar *et al.*, (2004) [5] the pH value of less than 4 and greater than 5 is lethal to the shrimps and other fin fishes. According to the observations of Ponce-Palafox *et al.*, (1997) [20] the moderate survival rate in juveniles of *P. vannamei* was reported when the temperatures were in between 20 to 30 °C. Whereas highest survival and growth values were recorded at temperature ranges of 28 to 30^0C. In the present study the temperature values were varied from 25.26 to 30.49 °C and the similar observations also noted for the best growth at 26-32 °C (Haliman and Adijaya, 2005) [14]. Van Wyk *et al.*, (1999) recorded less growth rates at 26 °C when compared to studies of Ponce-Palafox *et al.*, (1997) [20]. No growth rates were noticed when temperature reached to 22 °C.

In the present investigation, the dissolved oxygen is greater than 4.15 mg/l was quiet suitable for the shrimps and it was observed by Musig (1980) [18] and Boyd (1990) [6] in intensive shrimp farming as 3.5mg/l. According to Chen (1985) [9] the critical concentration of the dissolved oxygen in shrimp culture pond is 3.7 ppm. In the present findings the recorded average values of dissolved oxygen are greater than 5.2 mg/lit. According to Flegel *et al.*, (1995) [13] low dissolved oxygen condition can reduce the immune system and more prone to the diseases and mortality of shrimp. Chen *et al.*, (1986) [10] reported that dissolved oxygen level in the culture pond ranged between 4.0 and 8.0mg/l. In intensive aquaculture systems low levels of oxygen can effects quality of the pond waters (Boyd and Watten, 1989) [7]. According to Boyd (1990) [6] for healthy survival of cultured organisms more than 5 mg/l of dissolved oxygen is required. Several authors reported that at high density, the growth of juveniles are excellent but after the growth progresses, it was get suppressed.

5. Conclusion

Almost all forming sector, for increasing shrimp production increases stocking density, it may impacts on shrimp growth, health and pond environment due to increase in feed input usually increases the deterioration of pond. Hence, it is important to determine the shrimp density that is important for the farmer for better survival and faster growth. The results of this study may help farmers and biologists to choose a suitable stocking density for the production of quality of white shrimp in hatchery and nursery reared ponds due to stress response of shrimp increased by crowding. Our results may also suggest that the suitable cultural crop season for the better growth stage of white shrimp.

6. References

1. Aalimahmoudi M, Reyshahri A, Bavarsad SS, Maniat M. Effects of feeding frequency on growth, feed conversion ratio, survival rate and water quality of white leg shrimp (*Litopenaeus vannamei*, Boone, 1931). Int J Fish Aquat Stud. 2016;4:293-7.
2. Alcivar-Warren A, Meehan-Meola D, Park SW, Xu Z, Delaney M, Zuniga G. ShrimpMap: A low-density, microsatellite-based linkage map of the pacific whiteleg shrimp, *Litopenaeus vannamei*: Identification of sex-linked markers in linkage group 4. Journal of Shellfish Research. 2007;26(4):1259-1277.
3. Allan GL, Maguire GB. Effects of pH and salinity on survival, growth and osmoregulation in *Penaeus monodon* Fabricius. Aquaculture. 1992;107(1):33-47.
4. Balakrishnan G, Peyail S, Ramachandran K, Theivasigamani A, Savji KA, Chokkaiah M *et al*. Growth of cultured white leg shrimp *Litopenaeus vannamei* (Boone 1931) in different stocking density. Advances in Applied Science Research. 2011;2(3):107-113.
5. Bhatnagar A, Jana SN, Garg SK, Patra BC, Singh G, Barman UK. Water quality management in aquaculture, In: Course Manual of summerschool on development of sustainable aquaculture technology in fresh and saline waters, CCS Haryana Agricultural, Hisar (India); c2004. p. 203-210.
6. Boyd CE. Water quality in ponds for aquaculture. Alabama Agricultural Experiment Station, Auburn University, Alabama, USA; c1990. p. 482.
7. Boyd CE, Watten BJ. Aeration systems in aquaculture. CRC Critical Reviews in Aquatic Sciences. 1989;1:425-72.

8. Bray WA, Lawrence AL, Leung-Trujillo JR. The effect of salinity on growth and survival of *Penaeus vannamei*, with observations on the interaction of IHHN virus and salinity. Aquaculture. 1994;122(2-3):133-146.
9. Chen CJ, Shin TS, Lee CK. Effects of ammonia and nitrate on larval development of the shrimp Penaeus monodon. In: Proceedings of 1st Asian Fisheries Forum. Asian Fisheries Society, Manila, Philippines, 657-662 p. Chen, H.C. 1985. Water quality criteria for farming the grass shrimp, *Penaeus monodon.* Proceedings of 1st International Conference on Culture of Penaeid Shrimps. SFAFDEC, Aquaculture Dept. lloilo, Philippines, 1986.
10. Cheng JH, Liao IC. The effect of salinity on the osmotic and ionic concentrations in the haemolymph of *Penaeus monodon* and *Penaeus penicillatus*. In: Proceedings of 1st Asian Fisheries Forum. Asian Fisheries Society, Manila, Philippines, 1986, 633-636 p.
11. Dalla Via GJ. Salinity responses of the juvenile penaeid shrimp *Penaeus japonicus*: I. Oxygen consumption and estimations of productivity. Aquaculture. 1986;55(4):297-306.
12. Danya Babu Ravuru, Jagadish Naik Mude. Growth of cultured white Leg Shrimp *Litopenaeus vannamei* (Boone, 1931) of brackish water culture system in summer season with artificial diet. Advances in Applied Science Research. 2014;5(2):25-28.
13. Flegel TW, Fegan DF, Sriuratana S. Environmental control of infectious shrimp diseases in Thailand. In: Shariff, M., Arthus, J.R. and Subasinghe, R.P. (Eds.)., Diseases in Asian Aquaculture II, Fish Health Section, Asian Fisheries Society, Manila, 1995, 65-79 p.
14. Haliman, Adijaya. Vannamei shrimp, Cultivation and Market prospects of disease resistant white shrimp. (Jakarta: Penebar swadaya press), 2005, p75.
15. Jamabo NA. Ecology of *Tympanotonus fuscatus* (Linnaeus, 1758) in the mangrove swamps of the Upper Bonny River, Niger Delta, Nigeria. Ph.D. Thesis, Rivers State University, 2008, 340 p.
16. Keiser RK, Aldrich KV. Salinity preference of postlarval brown and white shrimp (*Penaeus aztecus* and *P.setiferus*) in gradient tank. Con. Mar. Sci. 1976;17:153-162.
17. Mair JM. Salinity and water-type preferences of four species of postlarval shrimp (Penaeus) from west Mexico. Journal of Experimental Marine Biology and Ecology. 1980;45(1):69-82.
18. Musig Y. Water quality and management in marine shrimp culture. Seminar of shrimp culture and nutrition, Diethelmpharmachem Ltd. and Rovithai Ltd. Bangkok, 1980, 1-9 p.
19. Paulraj R, Sanjeevaraj PJ. Effect of salinity on growth and survival of three species of penaeid prawns. Proceedings of the Symposium on Coastal Aquaculture. 1982;1:236-243.
20. Ponce-Palafox J, Martinez-Palacios CA, Ross LG. The effects of salinity and temperature on the growth and survival rates of juvenile white shrimp, *Penaeus vannamei*, Boone, 1931. Aquaculture. 1997;157(1-2):107-115.
21. Soundarapandian P, Gunalan B. Recent technology for the survival and production of giant tiger shrimp Penaeus monodon along south east coast of India. Int. J. Zool. Res. 2008;4(1):21-27.
22. Soundarapandian P, Ramanan V, Dinakaran GK. Effect of probiotics on the growth and survival of *Penaeus monodon* (Fabricius). Current Research Journal of Social Sciences. 2010;2(2):51-57.
23. Sturmer LN, Lawrence AL. Salinity effects on *Penaeus vannamei* production in nursery and growout ponds. Journal of the World Aquaculture Society, 1989, 20 (Abstract 73A).
24. Suprapto. Technical instructions for the cultivation white shrimp (*Litopenaeus vannamei)*. Bandar Lampung: Biotirta press), 2005, p25.
25. Van Wyk P, Davis-Hodgkins M, Laramore CR, Main KL, Mountain J, Scarpa J. Farming marine shrimp in recirculating freshwater systems. FDACS contact, M520. Florida Department of Agriculture and Consumer Services, Tallahassee, Florida, USA, 1999.