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Impact of Turbidity on the Specific Growth Rate of White Leg Shrimp (*Litopenaeus vannamei*) Grow-Out Phase, Nellore District, Andhra Pradesh, India

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ABSTRACT
In the Kandaleru creek area turbidity plays a major role in the specific growthrate (SGR) of shrimp in culture ponds. The turbidity effect on specific growth rates wasanalyzed in the present study. The treatment ponds R1, R2, and R3 were fed with clear water which was resulted from flocculation sedimentation and treatment, and were compared against the Control (C) which was fed with creek water directly. SGR and turbidity of Litopaeneus vannamei ponds were observed for two years (4 crops). The SGR in treatment ponds were varying from 2.586±0.0153 to 2.950±0.0153and in control ponds 2.57±0.020 to 2.75±0.020. The highest SGR was recorded in the treatment ponds R1 and R3 (2.950±0.0153) of crop-1, which has shown inverse relation to the turbidity. In each crop, the lowest SGR was recorded in control ponds (2.57±0.020 to 2.75±0.020) which were fed with higher turbidity 36.19±7.047 NTU to 47.65±4.009 NTU compared to the treatments. The changes in SGR were inversely significant to the turbidity at a 5% level of significance, and clear changes in SGR were observed in different crops.
Keywords: *Turbidity, Specific Growth Rate, Litopenaeus vannamei, Grow out ponds, Crops.*

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INTRODUCTION

Aquaculture is one of the fastest-growing food production sectors in the world which plays a significant role in eliminating hunger, promoting health, and reducing poverty. The intensification of culture-practices in the aquaculture sector is one of the best possibilities to increase aquaculture production. The growth of both rural and industrial aquaculture development is needed for the wellbeing of the sector as a whole. Shrimp culture is one of the fastest-growing segments in India. Besides, producers have no control over creek water quality, and operations using creek-water can develop serious contamination of organic load resulted from the discharges from aquaculture itself and surface runoff due to erosion through the system by water flow.

The aquaculture sector has been the target of much criticism from environmental groups, whose content has been exaggerated or ill-founded, more often than not [1]. Treatment of these shrimp wastes is often required before the water can be discharged into the environment. The spread and intensification of shrimp farming and poor management practices caused a high influx of organic load, sediments, and associated, increase stress levels on the aquatic organisms led to severe disease outbreaks and ready to collapse stage of aquaculture and thereby significant losses to the farmer.

However, this industry has been investigated for its contribution to environmental deterioration and pollution. The environmental sustainability of aquaculture in general, shrimp culture in particular, has received increasing attention in recent years [2]. The survival and sustainability of the industry will be determined primarily by the modus operandi of the operating practices, which will, by necessity have to be environmentally acceptable [3]. The effects of these activities can usually be minimized through proper management and early detection of problems. Despite these limitations, an attempt has been made here to address the turbidity influence on growth, survival, FCR, and biomass production of *Litopenaeus vannamei* in the grow-out ponds. This study was conducted to evaluate the turbid water's influence on growth rate increment to clear water in intensive white shrimp farming on land-based ponds.

MATERIAL AND METHODS

The locale of the study: The experimental site was located near the banks of Kandaleru Creek (14°22'44.98''N 80°06'39.41''E), in Nellore district of Andhra Pradesh.

Experimental set up: Experimental setup was made in such a way that the treatment ponds R1, R2, and R3 were fed with clear water which was resulted from flocculation sedimentation and treatment, and were compared against the Control (C) pond, which was fed with creek water directly, and also these ponds were seeded with the same density of the *Litopenaeus vannamei*. These ponds were filled with brackish water as a source of water. The present study was carried out for four crops (from February-May & September-December) of the years, 2016-18.

The turbidity was measured weekly using a turbidity meter (Hach 2100P Hack Company, Loveland, CO, United States). The reagent powder pillows and Hach spectrophotometer 2800 provided by Hach Company (Hach Company, 2002) were used in the determination.

Growth parameters were analyzedat regular intervals starting from the 35th day to till harvest. After harvest, the SGR was estimated. During the growth trial, all water quality parameters were maintained similarly except the turbidity.

The specific growth rate was calculated by the formula - $[(L_n \text{ FBW} - L_n \text{ IBW}) / \text{days}] \times 100$

FBW-Final body weight; IBW - Initial body weight; Ln–Logarithm.

The raw data obtained on SGR and turbidity were analyzed by using descriptive statistics and univariate analysis of variance and also by utilizing statistical software (or) package SPSS 16.0. version.

RESULTS AND DISCUSSION

In the present study, the turbidity in the treatment ponds was in the range of 4.38±0.606 to 6.02±0.906 NTU and the control pond 36.19±7.047 to 47.65±4.009 NTU (Table-1, Figure-1) throughout the experimental periods in different crops. Water turbidity refers to the quantity of suspended material, which interferes with light penetration in the water column. Turbidity limits light penetration thereby limiting photosynthesis in the pond. Higher turbidity can cause temperature and Dissolved oxygen stratification in shrimp ponds [4]. The flocculation/ coagulation with PAC (Poly aluminum chloride) and sedimentation might have played a significant role in reducing total suspended solids in the water and indirectly bringing down the turbidity in treatment ponds, final concentrations of suspended solids less than 10 mg/L. Fakhri*et al*., [5] also observed a decrease of TSS (Total suspended solids) in treatment ponds compared to control ponds. Treatment of pond water with flocculating agents and sedimentation for the rearing of shrimps by managing the concentration of TSS gave beneficial results [6, 7, 8]. As solids increase, so does biochemical oxygen demand potentially leading to decreased oxygen availability for shrimp both coagulation/flocculation aids also exhibited excellent settling [9].

Ebeling *et al*., [6] opined that the majority of the floc quickly settling out in the first 5min. Ebeling *et al*., [10] reported TSS removal was close to 99% settling by application of flocculating agents.

According to the results of this study low turbidity values were observed in treatments R1, R2, and R3 than the control, where the water source used after sedimentation (15 ppm PAC dose) and disinfection with chlorine, all factors of water-quality parameters were at optimum levels in the experimental ponds compared with the control except turbidity. Gaona*et al*., [11] felt that the application of flocculating agents, sedimentation, and treatment of water might have drastically brought changes in turbidity of treatment pond water which indirectly influenced the beneficial algal growth and improved water quality conditions resulted in growth rate and survival, the productivity of vannamei in treatment ponds. However, in this study other water quality parameters were not varied much for all the treatments. If in any case, changes observed were managed within the permissible limits through water exchange.

The observed SGR in treatment ponds for different crops were varying from 2.586±0.0153 to 2.950±0.0153 and in control ponds 2.57±0.020 to 2.75±0.020(Table-2, Figure-2, 3 & 4). The highest specific growth rate was2.95±0.0153in Treatments R1& R3 of crop-1 and the lowest was 2.570±0.020in Control pond of crop-2.

Table 1. Turbidity (NTU) in the experimental tanks of *L. vannamei* reared in different crops.

Crops	Ponds	Turbidity NTU	SD
1	Control	36.190	7.047
	R1	4.380	0.616
	R2	4.380	0.616
	R3	4.380	0.616
2	Control	38.910	9.057
	R1	4.720	1.109
	R2	4.720	1.109
	R3	4.720	1.109
3	Control	47.650	4.009
	R1	6.020	0.906
	R2	6.020	0.906
	R3	6.020	0.906
4	Control	46.930	3.805
	R1	5.780	0.542
	R2	5.780	0.542
	R3	5.780	0.542

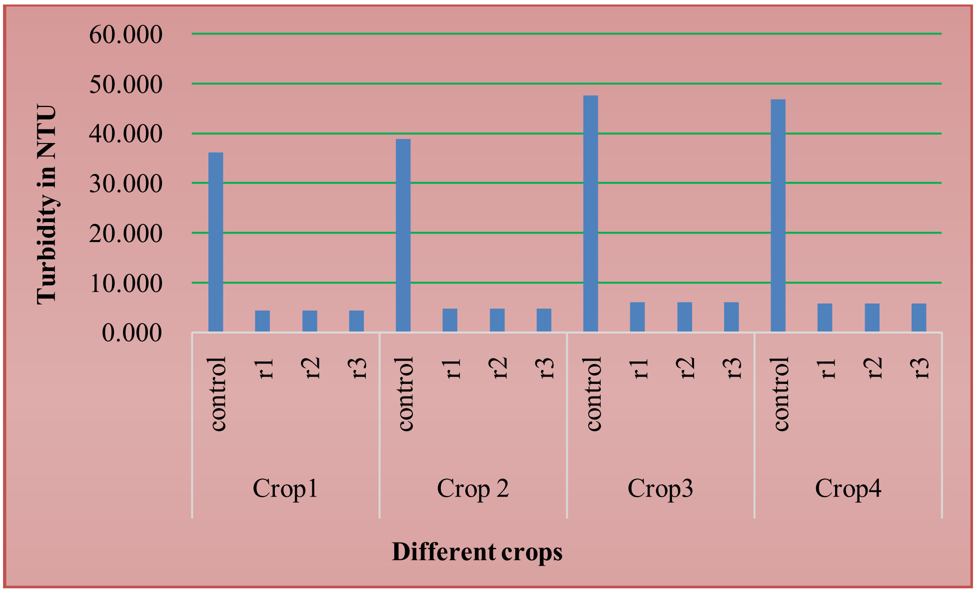

Figure 1.Turbidity(NTU) in the experimental tanks of *L. vannamei* reared in different crops.

Table 2. SGR of *L. vannamei* reared in different treatment ponds in different crops

Crops	Control	R1	R2	R3
Crop-1	2.75±0.0200	2.95±0.0153	2.75±0.0153	2.95±0.0153
Crop-2	2.57±0.0200	2.84±0.0100	2.78±0.0153	2.84±0.0100
Crop-3	2.59±0.0200	2.66±0.0200	2.78±0.0100	2.66±0.0200
Crop-4	2.58±0.0200	2.81±0.0153	2.58±0.0153	2.67±0.0100

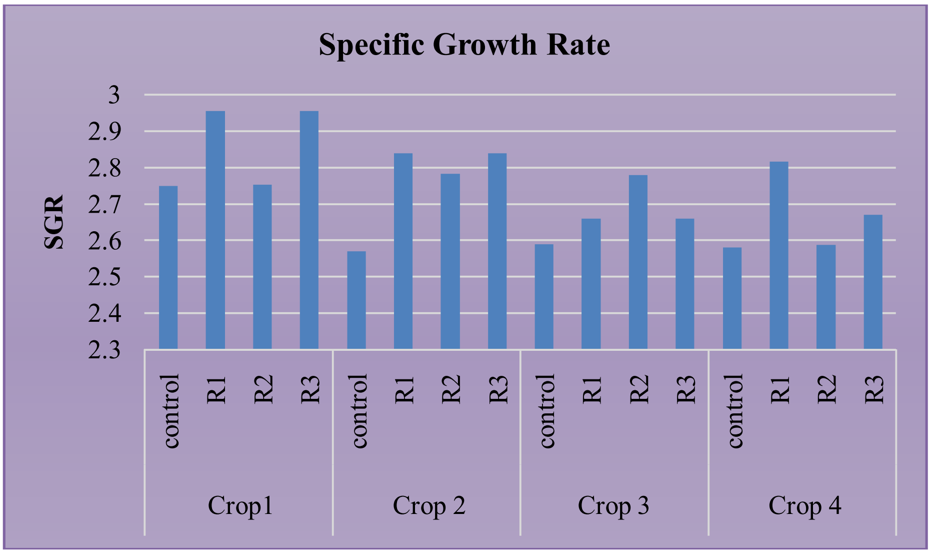

Figure 2. SGR of *L. vannamei* reared in different treatment ponds in different crops.

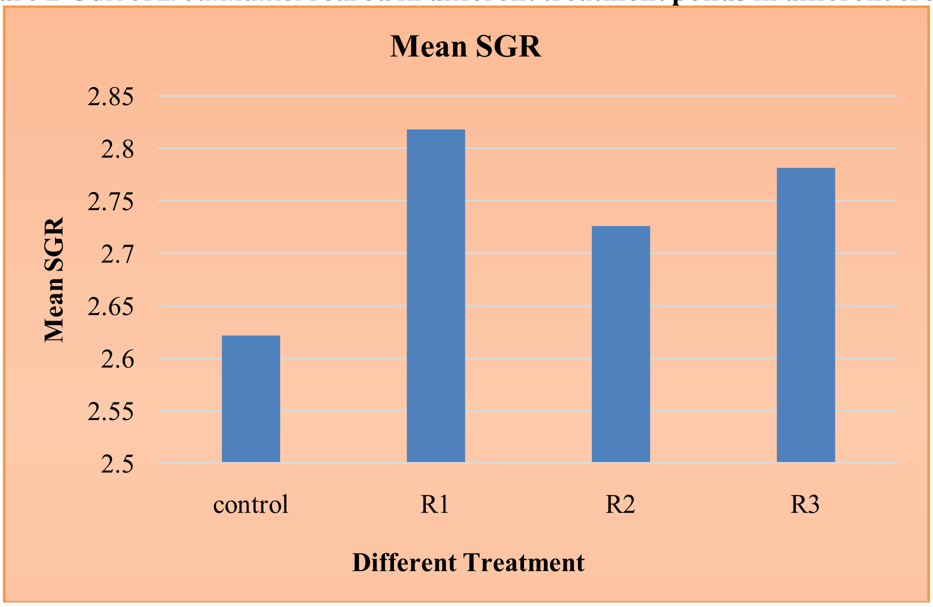

Figure 3. Mean Specific Growth rate of *L. vannamei*in different treatments

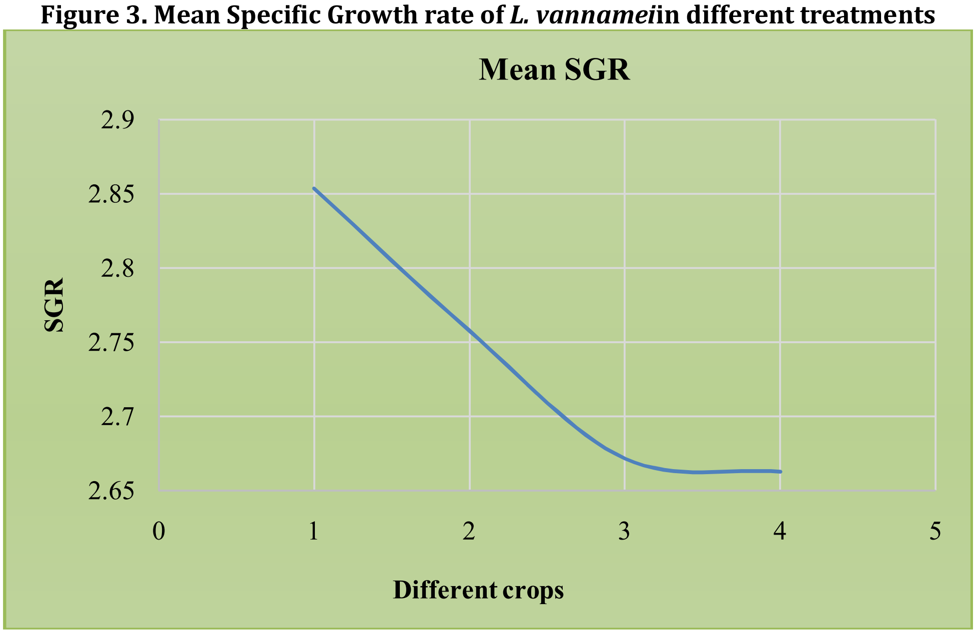

Figure 4.Mean SGR of *L. vannamei*in different crops.

SGR was subjected to the univariate analysis found to be significant at a 5% level of significance. treatment R1 and R3 of crop-1 were proved to be significantly superior (SGR=2.95±0.0153) compared to other treatments. The treatments were found significantly different from control.

The comparative analysis of control as one group and all other treatment groups against it was utilized in Dunnet T-test. The SGR data was significant at a 5% level of significance for the mean difference. The statistical analysis of SGR of *L. vannamei* subjected to pairwise comparisons, the mean difference was significant for the treatments ($p < 0.05$). The F–test for the effect on treatments in the univariate test of SGR means data in different crops showed significance. The mean SGR of *L. vannamei* in different crops were subjected to pair wise comparison and found to be significant ata 5% level of significance. The SGR was showed a similar statistical trend as observed in the ADG (Average daily growth) of shrimp.

Esparza-Leal. *et al*., [12] noticed a similar increase in the SGR of *Litopenaeus vannamei* the highest SGR (11.8±0.4) in the clear water treatment compared to the other treatments. Correia *et al*., [13] were reported that shrimp fed with high protein feed showed better growth performance (SGR-11.19 HP 40; SGR- 11.03 LP 30) compared to the low protein feed in contrast to earlier findings, whereas, Browdy *et al*., [2] reported when shrimp were fed 30% and 45% protein diet vannamei growth has no difference in shrimp performance at a density of 104 PL/m^2 in out-door ponds in the presence of natural productivity.

Ray *et al*., [14] were observed in the T-LS Treatment (T-Low Solids) shrimp grown at a significantly greater rate (1.7gm/week) versus (1.3gm/week) and reached significantly greater final weight (22.1 gm) versus (17.8 gm) than shrimp in the T-HS Treatment (T-High solids) sedimentation of solids with flocculants application could play a greater indirect role on the growth enhancement of the shrimp. The low solids presence in the water which was utilized for the culture of shrimp may have had greater access to the optimal water quality parameters and substantially reduced the stress levels might have increased growth of shrimp.

Chapman *et al*., [15] opined that higher particle concentration in intensive culture ponds can lead to gill clogging in the aquatic animal. Hargreaves [16] was reported an increased concentration of particles can suppress the growth of some potentially beneficial algae. It was also suggested that continually cropping out a portion of the microbial community produces a younger healthier community that may thereby provide enhanced nutritional benefits to cultured animals [17].Similar results were observed in the present study also.

Fine solids and organic compounds have been linked to gill irritations and disease outbreaks but effects are uncertain and information is scarce and also said the development of more relevant water quality criteria for reuse systems will require production-scale trials [18, 19]. Wyban *et al*., [20] noticed SGR was lowest at 23^{0}C and were (2.52±0.31) at 23^{0}C, (4.19±0.47) at 27^0 C, and (4.52±0.17) at 30^0 C. Water quality parameters associated with seasonal changes are one of the most important factors influencing the growth of the shrimp and showed that temperature as a major environmental factor determining the seasonal growth pattern of the shrimp.

Similarly, in the present study, all factors of water-quality parameters were at optimum levels in the treatment ponds compared with the control except turbidity.In our experiment, as the turbidity is the only parameter having much difference in treatments than the control, it might have played a major role in SGR.

CONCLUSION

In the present study, the growth of the shrimp was monitored once in a week from the 35th day onwards and the turbidity, shrimp specific growth rate for 4 crops of the years 2016 to 2018 were compared. During the sampling, the turbidity on weekly basis, SGR, yield, and survival were assessed at the time of harvest. The changes in SGR were inversely significant to the turbidity at a 5% level of significance, and clear changes in SGR were observed in different crops.

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REFERENCES

1. De Silva, S.S. (2001). A global perspective of aquaculture in the new millennium. In: Subasinghe, R.P., Bueno, P., Phillips, M.J., Hough, C., McGladdery, S.E. and Arthur, J.R. eds. Aquaculture in the Third Millennium. Technical Proceedings of the Conference on Aquaculture in the Third Millennium, Bangkok, Thailand, 20-25 February 2000. pp. 431-459. NACA, Bangkok, and FAO, Rome.

2. Browdy, C.L., Bratvold, D., Stokes, A.D., and McIntosh, R.P. (2001). Perspectives on the application of closed shrimp culture systems. In: Browdy, C.L., Jory, D.E. editors. The New Wave Proceedings of the Special Session on Sustainable Shrimp Culture, Aquaculture. The World Aquaculture Society, Baton Rouge, Louisiana, USA. Pages 20–34.
3. Beveridge, M.C.M., Phillips, M.J., and MacIntosh, D.J. (1997). Aquaculture and the environment: the supply and demand for environmental goods and services by Asian aquaculture and the implications for sustainability. Aquaculture Research, 28: 797-807.
4. Boyd, C.E. (1990). Water quality in ponds for aquaculture. Alabama Agricultural Experiment Station, Auburn Univ., Alabama USA., p. 482.
5. Fakhri, M., Budianto, B., Yuniarti, A., and Hariati, A. M. (2015). Variation in water quality at different intensive white leg shrimp, Litopenaeusvannamei, farms in East Java, Indonesia. Nature Environment and Pollution Technology, 14(1), 65-70.
6. Ebeling, J.M., Timmons, M.B., and Bisogni, J.J. (2006). Engineering analysis of the stoichiometry of photoautotrophic, autotrophic, and heterotrophic removal of ammonia–nitrogen in aquaculture systems. Aquaculture, 257(1-4), 346-358.
7. Cohen, J.M., Samocha, T.M., Fox, J.M., Gandy, R.L., and Lawrence, A.L. (2005). Characterization of water quality factors during intensive raceway production of juvenile *Litopenaeusvannamei* using limited discharge and biosecure management tools, Aquaculture Engineering, 32, 425-442.
8. De Schryver, P., Crab, R., Defoirdt, T., Boon, N., Verstraete, W. (2008). The basics of bio-flocs technology: the added value for aquaculture. Aquaculture, 277, 125–137.
9. Beveridge, M.C.M., Phillips, M., and Clarke, R. (1991). Aquaculture and water quality. A quantitative and qualitative assessment of wastes from aquatic animal production. Baton Rouge: The World Aquaculture Society, 506-533.
10. Ebeling, J.M., Rishel, K.L., and Sibrell, P.L. (2005). Screening and evaluation of polymers as flocculation aids for the treatment of aquacultural effluents. Aquacultural Engineering, 33(4), 235-249.
11. Gaona, C.A.P., Poersch, L.H., Krummenauer, D., Foes, G.K., and Wasielesky, W.J. (2011). The effect of solids removal on water quality, growth, and survival of *Litopenaeusvannamei* in a biofloc technology culture system.International Journal of Recirculating Aquaculture. 12. 54-73.
12. Esparza-Leal, H.M., Cardozo, A.P., and WasieleskyJr, W. (2015). Performance of *Litopenaeusvannamei* post larvae reared in indoor nursery tanks at high stocking density in clear-water versus biofloc system. Aquacultural Engineering, 68, 28-34.
13. Correia, E.S., Wilkenfeld, J.S., Morris, T.C., Wei, L., Prangnell, D.I., and Samocha, T.M. (2014). Intensive nursery production of the Pacific white shrimp *Litopenaeusvannamei* using two commercial feeds with high and low protein content in a biofloc-dominated system. Aquacultural Engineering, 59, 48-54.
14. Ray, A.J., Dillon K.S., and Lotz J. M. (2011). Water quality dynamics and shrimp (*Litopenaeusvannamei*) production in intensive, mesohaline culture systems with two levels of biofloc management. Aquacultural Engineering, 45(3):127–136.
15. Chapman, P.M., Popham, J.D., Griffin, J., Leslie, D., and Michaelson, J. (1987). Differentiation of physical from chemical toxicity in solid waste fish bioassays. Water, Air, and Soil Pollution, 33(3-4), 295-308.
16. Hargreaves, J.A. (2006). Photosynthetic suspended-growth systems in aquaculture. Aquaculture Engineering 34, 344–363.
17. Turker, H., Eversole, A.G., and Brune, D.E. (2003). Effect of temperature and phytoplankton concentration on Nile tilapia *Oreochromisniloticus (L.)* filtration rate. Aquaculture Research, 34: 453-460.
18. Colt, John. (2006). Water quality requirements for reuse systems. Aquacultural Engineering. 34, 143-156.
19. Zhang, S.Y., Li, G., Wu, H.B., Liu, X.G., Yao, Y.H., Tao, L., and Liu, H. (2011). An integrated recirculating aquaculture system (RAS) for land-based fish farming: The effects on water quality and fish production. Aquacultural Engineering, 45(3), 93-102.
20. Wyban, J., Walsh, W.A., and Godin, D.M. (1995). Temperature effects on growth, feeding rate, and feed conversion of the Pacific white shrimp (*Penaeusvannamei*). Aquaculture, 138(1-4), 267-279.

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