INT. J. BIOL. BIOTECH., 4 (1): 33-36, 2006.

GROWTH PERFORMANCE OF NEONATALS OF *CIRRIHANA MRIGALA* KEPT AT DIFFERENT STOCKING DENSITIES IN RECIRCULATING WATER SYSTEM

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ABSTRACT

For evaluation of growth rate of any aquatic organism, weight is the most reliable variable along with number of organisms stocked in confined space. The present study was focused on the suitable ratio (organism/sq.feet) of *Cirrhinus mrigala* at which they were exhibit best growth. The neonatal of *Cirrhinus mrigala* (0.5±0.15 g.) were stocked under two different systems i.e. raceways (8'x55'= 440 sq.ft) 5 in numbers and glass aquaria (1'x3 = 3 sq.ft) also 5 in numbers. They were fed with a mixed diet containing rice protein 40%, rice polish 30%, rice bran 20% and rice flour 10 %. All raceways were stocked @ 2.27, 9.09, 33.36, 40.90 and 45.45 neonatal/ sq.ft and all aquaria were stocked @ 3.00, 9.09, 33.33, 41.00 and 45.33 neonatal/ sq.ft. The specific growth rate (SGR) was observed to be the best in raceway # 4 (17.0) compared to other raceways 7,8,14 & 15 with sequence of raceways # 1,2,3,5 as well as to the aquarium (5,3,2,2,1). The weight gain was also found to be significant in raceways 3,4 and 5 (4.6,5.3 and 4.3 g. respectively). The computed neonatal production per year was significantly increased from 84 to 204g when optimal ratio existed between space and stocking rate.

Key words: Stocking density, recirculating carp culture, crowding effects on growth.

INTRODUCTION

Carps are the most important farm fish in the aquaculture to fulfill global demand with relation to population growth. Carp culture has been greatly improved with advances in culture techniques and scientific approaches in management. However lack of space and water restricts successful short and long-term rearing of carps. Although the supply of fingerlings not affects the production rate. The production can easily be enhanced by high stocking rate. Stocking density is one of the most important factors that directly affect fish growth, feed utilization and gross fish yield (Lin and Chang, 1992). Higher stocking density may cause adverse hydro-biological conditions, which ultimately link with poor growth and survival. The information regarding the rearing of neonatal, especially the effects of stocking density and growth performance is limited, inconsistent and some times controversial. Studies were conducted using different culture system such as tanks (Baily *et al.*, 2000) pond (Diana *et al.*, 1996) and net cages (Cruz and Ridha, 1991; Yi *et al.*, 1996; Oualtara *et al.*, 2003). The results of these studies generally demonstrated an inverse relationship between stocking density and growth rate. The fish intensification by increasing stocking density is suitable method to increase fish yield to over come the problem of land shortage (Khattab *et al.*, 2004).

In developing countries, successful stock enhancement programs are associated with water reservoirs e.g. India (Sugunan, 1995; Desilva, 2001). Some workers have studied the relationship between stocking density, area and yield for the reservoir (Li and Xu, 1995; Quiros, 1995; Amarasingha, 1998; Wekomme and Bartley, 1995; Phan and Desilva, 2000; An, 2001; Sugnan, 2001).

In Pakistan no analytical study has examined whether size of pond and stocking density influence on growth performance. This study attempts to establish relationships between stocking density, area and yield of commercial fishpond.

MATERIALS AND METHODS

This on-farm experiment was carried out during the months of February to April (90 days). For the proposed study, a series of two different experimental setup (Raceways 440 sq.ft and aquaria 3 sq.ft) were conducted based on size and area. Five raceways were stocked at different stocking densities range from 1000 to 20,000 fingerlings (0.5 g. average initial weight). Beside this aquaria also five in numbers were stocked at the density range from 9 and 136 finger lings (0.5 g. average initial weight). Water level was kept remain same by regular addition. All the fingerlings were fed thrice a day a mixture of powdered protein, reg. feed, rice flour and rice polish @ of 3% of body weight. Weekly observations were taken for analysis of growth performance. Dissolved oxygen, nitrates, nitrites, ammonia and pH were also recorded on daily basis.

Table 1. % Survival and weight gain of *Cirrihanus mrigala* at different stocking densities in raceways.

Raceways	Biomass stocked	% Survival	Mean initial weight (g.)	Mean final weight (g.)	Weight gain (g.)
1	1000@2.27	83	0.5	2.8	2.3
2	4000@9.00	78	0.5	3.1	2.6
3	16000@33.36	73	0.5	5.1	4.6
4	18000@40.9	68	0.5	5.8	5.3
5	20000@45.45	52	0.5	4.8	4.3

Table 2. Daily weight gain, SGR and computed value of annual production of *Cirrihanus mrigala* in raceways at differential stocking densities.

Raceways	Daily weight gain	SGR	Production/year (g.)
1	0.07	7.0	84
2	0.08	8.0	96
3	0.15	15.0	180
4	0.17	17.0	204
5	0.14	14.0	168

Table 3. % Survival and weight gain of *Cirrihanus mrigala* at different stocking densities in glass aquaria.

Aquaria	Biomass stocked	% Survival	Mean initial weight (g.)	Mean final weight (g.)	Weight gain (g.)
1	9@3.00	76	0.5	2.1	1.6
2	27@9.00	62	0.5	1.5	1.0
3	100@33.33	53	0.5	1.3	0.8
4	123@41.00	42	0.5	1.1	0.6
5	136@45.33	31	0.5	0.8	0.3

Table 4. Daily weight gain, SGR and computed value of annual production of *Cirrihanus mrigala* in aquaria at differential stocking densities.

Aquaria	Daily weight gain	SGR	Production/year (g.)
1	0.05	5.0	60
2	0.03	3.0	36
3	0.02	2.0	24
4	0.02	2.0	24
5	0.01	1.0	12

RESULTS

GROWTH PERFORMANCE IN RACEWAYS

Results of fish growth are presented **in** Table 1& 2. It was noticed that with the increased stocking densities % survival starts to gradually decline through out the experimental period. The weight gained by the fingerlings stocked at 1000@ 2.27 individuals in raceway 1 was 2.3 g with maximum survival rate. Raceways 2 to 5 exhibited significantly increased weight gain with variable survival rate i.e. 78, 73, 68 & 52% followed by 2.6, 4.6, 5.3 & 4.3g. In term of weight increment on daily basis all fingerlings in raceways 3 to 5 a marked increase except in raceway 1& 2. The specific growth rate (SGR) was also found to be significant in raceway 3 to 5. The computed value of production per year clearly demonstrated a high increase in raceway 4 (204 g) followed by raceway 3 (180 g) and raceway 5 (168g).

GROWTH PERFORMANCE IN AQUARIA

Same weighed fingerlings of *Cirrihanus mrigala* (0.5g) were tested by rearing in glass aquaria. Table 3 & 4 reveal the pattern of growth. It was observed that when the fingerlings stocked from low to high density (9, 27, 100, 123 and 136 individuals), % survival was found to be decline with numerical values of 76, 62, 53, 42 and 31% respectively. The weight gain by the experimental fingerlings was significantly decreased with the proportional increase of stocking. With reference of weight increase on daily basis it was observed a serial decline in all aquaria. The computed values of production per year were 60, 36, 24, 24 and 12 g along with lesser value of SGR i.e.5, 3, 2, 2 and 1 on aquaria 1 to 5.

DISCUSSION

Stocking of fish is frequently used throughout the world but the extent, efficiency and utilization are poorly recorded for recirculating water system (Cowx 1994 and Lorenzen *et al*., 2001). The present investigation describes the interaction between growth and stocking density. From the results of rearing cycle, it is possible to predict the production round the year under spacious and non-spacious culturing system. The pattern of growth of *Cirrhinus mrigala* is indicative to the fact that the available space per individual is greatly influenced. The fingerlings kept in raceways can easily accommodate themselves and there is little competition for food and space for movement. The growth performance of *C. mrgala* in aquaria highlights the fact that available area is the only factor, which regulate growth enhancement. This is confirmed by the data of Knud-Hansen and Lin (1996), who observed a direct relationship between density and yield and then a dramatic decrease of yield for the highest densities. Yield decrease at high density can be explained by the situation of food competition leading to slower growth and higher relative management needs.

Suresh and Lin (1992) obtained a significantly higher mean daily weight gain (0.77g fish/day) for 75g red tilapia stocked at a density of 100 & 200 fish/m^3. Under crowded conditions at higher stocking densities fish suffer stress as a result of aggressive feeding interaction and eat less, resulting in growth retardation suggested by Zonnereld and Fadholi (1991). The current study demonstrates that carps respond with a mild activation of the stress response when reared at higher stocking densities with transient elevations of plasma cortisol and glucose. Moreover, as stocking density increases, the carrying capacity remains largely the same and density dependent growth occurs, whereas biomass at harvest is more consistent, regardless of stocking density. In the present study reduction in growth and % survival, which occurred at density did not appear due to poor water quality; as the water quality did not differ significantly in both raceways and aquaria. Thus, the reduced survival and growth at higher density appear to be lesser area of rearing, not to water quality. Also, as the growth rate declines without concomitant declines in water quality, it may possible that feeding rates were too low at high stocking density rate.

REFERENCES

Amarasinghe U.S. (1998). How effective is the stocking strategies for the management of reservoir. Fisheries in Sri Lanka? In: *Stocking and Introduction of Fish* (I.G. Cowx ed.). Oxford: Fishing New Books, Blackwell Science, pp. 422–436.

An N.Q. (2001). Effectiveness of stocking in reservoirs in Vietnam. In: *Reservoir and Culture-based Fisheries: Biology and Management* (S.S. De Silva ed.). Canberra: Australian Centre for International Agricultural Research, pp. 235–245.

Bailey D.S., J.E. Rakocy, J.M. Martin and R.C Shultz. (2000). Intensive production of tilapia fingerlings in recirculating system. In: *Proceeding of the Fifth International Symposium on Tilapia in Aquaculture*, Rio de Janeiro, Brazil (ed. K. Fitzsimmons & J.C. Filho), pp. 328^333. Panorama da Aquicultura Magazine, Rio de Janeiro, Brazil.

Cowx I.G. (1994). Sstocking strategies. *Fisheries Management and Ecology* 1: 15-30.

Cruz E.M. & M Ridha. (1991) Production of the tilapia *Oreochromis spilurus* stocked at different densities in sea cages. *Aquaculture,* 99: 95-103.

De Silva S.S. (2001). Reservoir fisheries: broad strategies for enhancing yields. In: *Reservoir and Culture-based Fisheries: Biology and Management* (S.S. De Silva ed.). Canberra: Australian Center for International Agricultural Research, pp.7–15.

Diana J.S., Y. Yi. and C.K Lin (2004) Stocking densities and fertilization regimes for Nile tilapia (*Oreochromis niloticus*) production in ponds with supplemental feeding. In: *Proceedings of the Sixth International Symposium on Tilapia in Aquaculture, Manila, Philippines* (ed. R. Bolivar, G. Mair & K. Fitzsimmons), pp.487^499. BFAR, Philippines.

Khattab Y.A.E., M. Abdel-Tawwab. & M.H Ahmad. (2004) Effect of protein level and stocking density on growth performance, survival rate, feed utilization and body composition of Nile tilapia fry (*Oreochromis niloticus* L.). In: *Proceeding of the Sixth International Symposium on Tilapia in Aquaculture, Manila, Philippines* (ed. R. Bolivar, G. Mair & K. Fitzsimmons), pp. 264^276. BFAR, Philippines.

Knud-Hansen, C.F., C.K Lin. (1996). Strategies for stocking Nile tilapia (*Oreochromis niloticus*) in fertilized ponds. In: *The Third International Symposium on Tilapia in Aquaculture* (Pullin, R.S.V., Lazard., J., Legender, M., Amon Kothias, J.B., Pauly, D. eds.). ICLARM Conf. Prroc. 41,pp. 70-76.

Li S. and S. Xu. (1995). *Capture and Culture of Fish in Chinese Reservoirs*. Ottawa: International Development Centre, Canada, pp.125.

Lin K.M. and W.B. Chang. (1992) Bioenergetics modeling of effect of fertilization, stocking density, and spawning on growth of the Nile tilapia, *Oreochromis niloticus* (L.). *Aquaculture and Fisheries Management*, 23: 291^301.

Lorenzen K., U.S. Amarsinghe, D.M. Bartley., J.D. Bell, S.S. De Silva., C.j. C.j. Garaway., W.D. Hartmann., J.M. Kaptesky, P. Laleye, J.Moreau, V.V. Sugunan.& D.B. Swar (2001). Strategy review of enhancements and culture-based fisheries. In: *Aquculture in Third Millennium. Technical Proceedings of the Conference on Aquaculture in the Third Millennium, Bangkok, Thailand*, 20-25 Feb 2000. Rome: FAO, 471 pp.

Ouattara N.I., G.G. Teugels, V.N. Douba & J.C. Philippart. (2003) Aquaculture potential of the black-chinned tilapia, S*arotherodon melanotheron* (Chiclidae). Comparative study of the effect of stocking density on growth performance of landlocked and natural populations under cage culture conditions in Lake Ayame (Cote d'Ivoire). *Aquaculture Research*, 32,1223-1229.

Phan P.D. and S.S. De Silva (2000). *The fisheries of the Ea Kao reservoir, southern Vietnam: a fishery based on a combination of stock and recapture, and self-recruiting populations*.

Quiros R. (1995). Relationships of Fish Yield to Fishing Effort and Stocking Rate in Reservoirs of Latin America and the Caribbean. *Tampa, FL, USA: American Fisheries Society 125th Annual Meeting*, 27–31 August 1995, 172 pp.

Sugunan V.V. (1995). Reservoir fisheries in India. *FAO Fisheries Technical Paper* 345, 423 pp.

Sugunan V.V. (2001). Status of culture-based fisheries in small reservoirs in India. In: *Reservoir and Culture-based Fisheries: Biology and Management* (S.S. De Silva ed.). Canberra: Australian Centre for International Agricultural Research, pp.274–280.

Suresh A.V. and C.K. Lin. (1992). Effect of stock density on water quality and production of red tilapia in a recirculating water system. *Aquacultural Engineering*, 11: 1-22.S

Welcomme R.L. and D.M. Bartley (1998). An evaluation of present techniques for the enhancement of fisheries. In: T. Petr (ed.) Inland Fishery Enhancements, *FAO Fisheries Technical Paper* 374.Rome: FAO, pp.1–35.

Yi Y., C.K. Lin and J.S. Diana (1996). Influence of Nile tilapia (*Oreochromis niloticus*) stocking density in cages on their growth and yield in cages and in ponds containing the cages. *Aquaculture*,146: 205-215.

Zonneveld, N. and R. Fadholi. (1991). Feed intake and growth of red tilapia at different stocking densities in ponds in Indonesia. *Aquaculture*, 99: 83–94.

(*Accepted for publication December 2006*)