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Effect of Stocking Size of *Clarias batrachus* Fry on Growth and Survival During Fingerling Hatchery Production

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Abstract

An experiment of four weeks duration was conducted to determine the effect of fry size at stocking for optimum growth and survival during fingerling production of *Clarias batrachus*. Size of fry was categorized based on weight class i.e 0.06 ± 0.003, 0.04 ± 0.002, 0.02 ± 0.003 g during initial stocking. No significant ($P < 0.05$) difference could be found in total length increment between 0.02 and 0.04 g weight class at the end of second week during rearing. However, length increment was significantly reduced in the smaller fish group compared to other groups during final harvesting. The increase in weight among the three treatments followed the same trend as that of length increment during the entire four-week experiment. The specific growth rate and per cent weight gain was significantly higher ($P < 0.05$) in smaller fish group (0.02 g) than higher groups during the experiment. Survival rate was significantly reduced while stocking 0.02 g fish compared to 0.06 g fish group during fingerling production.

Introduction

Clarias batrachus is recognized as an important candidate species for aquaculture, as it meets many economic criteria for a candidate species. Its hardy nature to adverse ecological conditions enables its culture with high stocking densities at a production up to 100 $t{\bullet}ha^{-1}$ (Areerat 1987). Non-availability of quality seed is the major constraint to the wide spread aquaculture of this species. Cultivation techniques for *C. batrachus* consist of three basic steps: (1) primary rearing phase (larvae to fry); (2) secondary rearing phase (fry to fingerling/juvenile) and (3) final rearing phase (growing to marketable size). There is great variation in growth and survival in field conditions during the secondary rearing phase. De Graaf et al. (1995) and Hecht et al. (1988) have mentioned the variability in growth and survival during fingerling production by stocking hatchlings or fry of *Clarias gariepinus* in the nursery pond. During production of fingerlings, the size of fry at stocking is an important criterion apart from stocking density, suitable feed and water quality for high survival and growth. Preliminary results indicated that density could be a factor during fingerling production of this fish species (Sahoo et al. 2002). It is often found that intensive rearing during the primary phase in our hatchery produce smaller fry, which show poor growth and survival during the secondary rearing phase. As such, it is important to investigate the optimum stocking size of *C. batrachus* fry for better growth and survival during fingerling production. The size of fish during stocking determines the economic viability of all types of production systems. Several studies have addressed the issues of optimum stocking size for channel catfish (Krummich and Heidinger 1973, Powel 1976, Spinelli et al. 1985). Reports on the optimum size of *C. batrachus* fry at stocking for fingerling production are scarce. Hence this study was conducted to determine the optimum stocking size of fry based on growth, survival and biomass gain.

Materials and Methods

C. batrachus fry were collected after the primary rearing phase from the catfish hatchery of the Central Institute of Freshwater Aquaculture, Kausalyaganga, Bhubaneswar, India. The average wet weight of fry was considered as the treatment size and graded into three homogenous size groups. The initial individual length and weight of 50 fry were recorded separately for each group before stocking. The initial length was measured using a standard fish measuring board and weight was recorded by electronic digital balance provided with ± 0.0001 g accuracy. The fry were dried on clean blotting paper before measuring and recording the wet weight. The three size groups of fry were 0.06 ± 0.003, 0.04 ± 0.002 and 0.02 ± 0.003 g in weight and 1.94 ± 0.06, 1.62 ± 0.05 and 1.16 ± 0.03 cm in length, respectively. Nine rectangular cemented tanks (4 x 0.5 m) were prepared seven days prior to stocking and kept in an open area under natural light conditions. The aerated ground water was stored in the over head cement tank to reach the normal ambient temperature. The bottom of the tanks were uniformly spread with one-inch depth of soil and filled with 30 cm water. Each tank was manured with 4 kg of cowdung and 20 g mono super phosphate. One-third of each tank surface was covered by palm leaves to provide shade to fish during sunny days. For each size group, three tanks were utilized and stocked at the rate of 200 fry•m^{-2}. Rearing was carried out for a period of four weeks. The body weight and total length were measured and recorded at weekly intervals. Thirty fry were randomly collected from each tank during sampling to determine individual total lengths and weights of fish. The fish were fed with laboratory prepared fish meal based pelleted feed (2 mm dia), containing about 30% crude protein (Giri et al. 1999). The pellets were crumbled and sieved to get the desired size. Daily ration was given at 10% of wet body weight in two equally divided meals, at 10 A.M. and 4 P.M. Fifty per cent of the tank water was renewed at one day intervals. The water temperature and dissolved oxygen level of the water in the rearing tanks ranged from 27 to 30ºC and 5.5 to 6.1 ppm, respectively, during the entire rearing period. At the end of the experiment, the changes in body length, weight, total biomass and per cent survival were measured and recorded. The specific growth rate (SGR) and per cent weight gain were calculated as follows:

Specific growth rate = {(ln final weight–ln initial weight)/Days of experiment} x 100

Per cent weight gain = {(Final weight - Initial weight)/initial weight} x 100

Data were analyzed by variance component analysis (Snedecor and Cochran 1967) and differences between the means was examined using Duncan's multiple range test.

Results and Discussion

The growth performance of the fry in the three treatment groups (0.02, 0.04, 0.06 g) is presented in table 1. After four weeks of rearing the final length of fingerlings in tanks stocked with 0.06 and 0.04 g fry were similar, but higher than that in the 0.02 g fry group. This might be due to the higher initial length during stocking. The weekly increase of total body length is depicted in figure 1. There was no difference ($P < 0.05$) in length between 0.02 and 0.04 g weight group fry at the end of the second week, but during the next two weeks the length of fry in the 0.04 and 0.06 g weight groups did not vary between each other. It might be due to the narrow length variation between the two larger groups during stocking in which the 0.04 g group may have compensated in length increment during the last two weeks. The final weight was similar and significantly higher in the two higher weight groups compared to the 0.02 g weight group fry in our study. It was observed that the smaller fry of 0.02 g weight group grew less efficiently than the higher weight group fry. Brett (1979) was in opinion that growth rate is principally influenced by three variables *viz.*, size, ration and temperature. Since the ration and temperature remained constant in the present study, the variation in growth rate of fry over the time might be due to size differences during stocking. The trend of growth during four weeks of rearing is presented in figure 2. The weekly increase in weight followed the similar trend as in length increment. The slower growth of fry when stocked with lower initial weight might be due to the reduced proportion of feed intake, which agrees to the observation of Tidewell and Webster (1993). Larger fry tend to have better-developed organs (eyes, olfactory system, nervous system, brain) for capture of feed particles, better consumption capability, strong musculature for swimming, more developed organs for digestion and absorption of feed, which resulted in higher growth. Huang and Chiu (1997) also observed that in tilapia bigger fry always grew faster.

In this study the fry with an initial weight of 0.04 g perhaps compensated the growth rate after second week and became at par in growth with higher body weight fry (0.06 g) during four weeks of rearing. The SGR and per cent weight gain were similar in trend and significantly higher in the tanks stocked with lowest weight group fry. This could be due to lower initial mean weight of fry during stocking. The per cent survival was the highest in the 0.06 g stocking weight fry. The higher survival in tanks stocked with larger weight fry could be due to their enhanced ability to search and utilize feed, and lower mortality compared to smaller fry. In an investigation, Storck and Newman (1988) reported that when smaller *Ictalurus punctatus* were stocked, they suffered more natural mortality and predation. The final biomass decreased with decrease in fry weight. The higher biomass was due to higher survival as well as growth of fry in the tanks stocked with bigger fry.

Table 1. Growth performance of different size groups of *C. batrachus* fry and changes in total length and weight, SGR, per cent weight gain and survival rate (mean ± SE) during four-week rearing period

Initial stocking weight of fry (g)	Final weight of fingerlings (g)	Final total length of fingerlings (cm)	Specific growth rate	% weight gain	% Survival	Final biomass (g)
0.06±0.003[a]	0.73±0.03[a]	4.40±0.04[a]	8.32±0.13[c]	1122±450.51[c]	73±1.73[a]	426±20.75[a]
0.04±0.002[b]	0.68±0.05[a]	4.25±0.10[a]	9.38±0.31[b]	1592±144.57[b]	66±2.40[ab]	358±18.80
0.02±0.003[c]	0.508±0.02[b]	3.80±0.02[b]	10.78±0.10[a]	2450±76037[a]	57±4.05[b]	232±9.59[c]

Mean values followed by different superscripts in a column differ significantly ($P<0.05$)

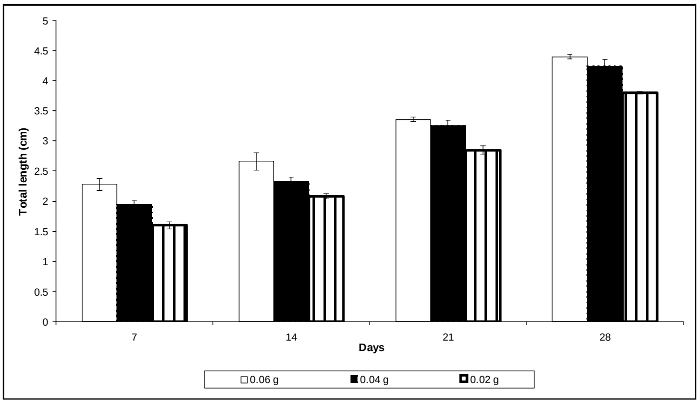

Fig. 1. Weekly changes in total length of *C. batrachus* fry stocked with different size groups during four-week fingerling production in the hatchery

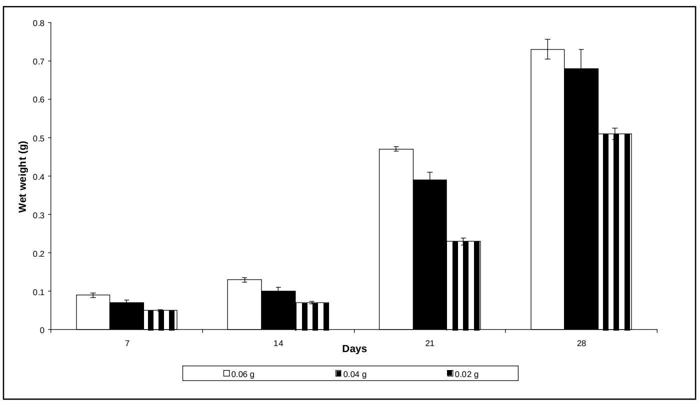

Fig. 2. Weekly changes in body weight of different size groups *C. batrachus* fry during four-week fingerling production in hatchery

Conclusion

The study indicated that stocking of undersized fry (< 0.02 g) should be avoided during fingerling production, which affects the profitability of a hatchery due to poor growth and survival. It is recommended that 0.04 to 0.06 g *C. batrachus* fry be stocked during the secondary rearing phase as the growth and survival of fingerlings were superior and did not differ between the two size groups.

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