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GROWTH RESPONSE AND SURVIVAL RATE OF *Clarias gariepinus* FRY CULTURED UNDER DIFFERENT BIOSHADES

Okunsebor, S.A and Mohammed, R.

Department of Aquaculture and Fisheries Management, Nasarawa State University Keffi, Shabu-Lafia Campus.
Email address: okunseborsa@yahoo.com
Phone contact: 08065142516

Abstract
The effect of direct sunlight, biological shade and total darkness on growth responses and survival rate of Clarias gariepinus fry in a concrete pond were investigated using four treatments in triplicate; unshaded Sunlight concrete pond (USCP), water lettuce shaded concrete pond (WLCP), water hyacinth shaded concrete pond(WHCP) and total darkness shaded concrete pond (TDCP). Each treatment was stocked with fifty (50) fry of Clarias gariepinus under flow through system. Fish were fed 3 times (6:00 am, 12:00 pm and 6:00 pm) daily at 3% body weight for six (6) weeks. The water quality parameters monitored shows no significant difference ($p>0.05$) between the treatments and range between; temperature 26.02-26.31°C, dissolved oxygen 7.10-7.11 mg^{-1}, total alkalinity 15.10 – 15.15 mg^{-1}, and free carbon dioxide 4.02 – 4.05 mg^{-1}. The survival rate for WLCP, WHCP, TDCP and USCP was 89%, 81%, 63% and 57% respectively. Mean weight gain, specific growth rate and condition factor were significantly higher in WLCP and WHCP, (2.309g, 9.69g, 2.13 and 2.318g, 9.66g, 2.00) respectively than USCP and TDCP. Therefore the use of water lettuce and water hyacinth as a biological shade for raising Clarias gariepinus fry is highly recommended.
Keyword: *Clarias gariepinus, biological shade, water lettuce, water hyacinth, survival rate*

Introduction

The African catfish *Clarias gariepinus* is one of the most important species currently being farmed in Nigeria. Its rapid growth rates, efficient utilization of supplementary feed and ease of production in captivity makes it an excellent candidate for aquaculture (Appelbaum and Kamler, 2000). The growth and survival of catfish are known to be strongly influence by photoperiod and shelter (Hecht and Appelbaum, 1988). As interest in fish farming especially in catfish is on increase, there is need for an increased research effort in solving the production constraints.

Eichhornia crassipes (Water hyacinth) and *Pista stratiotes* (Water lettuce) are aquatic plant of high economic value, they anchor soft sediment, stabilize under-water slopes; remove suspended particles and excess nutrient from overlying water (Madsen *et al*., 2001). Water lettuce is used as a way of controlling nutrient levels in fish pond water and to provide some shady cover to ponds, it has a thick root system which grows below the surface of the water offering spawning ground for fish and also serving as a source of food.

Water hyacinth is a free floating perennial plant native to tropical and sub-tropical South America, with broad, thick, glossy, ovate leaves, the root is blackish coloration and can grow in excess of 12 inches long the roots are often utilized by fish, they absorb impurities and can lock up floating particles from the water.

One of the simple, low cost techniques that can be used to obtain quality fish seed and faster growth during intense production of catfish is the use of water hyacinth and water lettuce as a bio-shade manipulation (Okunsebor *et al.,* 2016).

The purpose of this study is to find out whether rearing in darkness and the use of biological shade (water hyacinth and water lettuce) could be used as a method to improve survival rate and growth response of *C. gariepinus* fry under cultivation.

Materials and Method

Study Area

The experiment was conducted at the Fisheries unit Experimental Farm, Department of Fisheries and Aquaculture Management, Faculty of Agriculture, Nasarawa State University Keffi, Shabu-Lafia Campus. Lafia is located on latitude 8°35ˆN, Longitude 8°32'E, altitude 181.53m above sea level with mean temperature of 34°C, Relative humidity of 40-86% and average day light of 9-12h (NIMET 2011).

Experimental Fish

Six hundred (600) *C. gariepinus* fry was obtained from the hatchery unit of the Department of fisheries and aquaculture fish farm, acclimatized for a period of seven days, during which they were fed three times daily at 3% of their body weight.

Experimental Design

The experiment was carried out in four treatments: unshaded sunlight concrete pond (USCP), water lettuce shaded concrete pond (WLCP), water hyacinth shaded concrete pond (WHCP) and total darkness shaded concrete pond (TDCP) in triplicates for the period of six (6) weeks. After acclimatization fish was selected at random and stocked at 50 fry per pond containing 50 litres of borehole water. Prior to stocking, water quality parameters was measured, biometric parameters like total length, standard length and body weight was measured using standard measuring ruler and a digital weighing balance (Metter Toledo AB 34).
Feeding was done 3 times daily (0600, 1200 and 1800) at 3% body weight. Flow through system was ensured through out the period of the experiment, sampling was done at the beginning and end of the experiment to determine the growth response of the fry and mortality was counted and recorded. Water quality parameters was monitored using water testing kits

Parameters measured: the following data were analysed according to Akinwole et *al.,* 2014

- Weight Gain (g) = $W_f - W_i$
- Percentage Mean weight Gain(g) = (Wf-Wi) ×100/Wi
- Specific Growth Rate (SGR) = 100 × (In wf -In wi) / t
- Total increase length (cm) = final total length – initial total length
- Condition Factor **(**CF) = 100 × [wet body weight (g) / (body length cm)^3].
- Survival rate (SR) = [(final number of fish ×100)/Initial number of fish]

Where

Wi = Initial weight,

Wf = Final average weight

t = Number of days.

Statistical Analysis
Data Collected was analyzed using Analysis of Variance (ANOVA) and significant mean was separated at 0.05%

Results
Growth performance of *C. gariepinus* fry under different sunlight shaded condition
The result of the mean weight gained of fry under different shade condition shows significant difference ($p < 0.05$) between the control (USCP) and other treatments the result reveal that the highest mean weight gain 2.318g was obtained in WHCP and the lowest mean weight gained in the TDCP(1.341g).

The highest percentage mean weight gain (5975.0) was obtained in WHCP, while the lowest percentage mean weight gained (3352.5) was recorded in TDCP, this shows that there was no significant different ($P>0.05$) in percentage mean weight gained among WLCP (5772.5) and WHCP (5795.0) While significant difference ($p<0.05$) occur between the control USCP and other treatments.

The specific growth rate was higher in WLCP (9.69±0.03), followed by WHCP (9.66±0.04) and lowest was record in TDCP (8.38±0.03). There was significant difference ($p<0.05$) in specific growth rate among the treatments, but there was no significant difference ($p>0.05$) between WLCP and WHCP. The results obtained are presented in table 1.

The result of the condition factor of *C. gariepinus* fry under different sunlight condition revealed that, the condition factor was highest (2.13±0.03) in WLCP and lowest (0.72±0.01) in TDCP. There was significant difference ($P<0.05$) among all the treatments.

The results are shown in table 1 below.

Table 1: Growth Parameters and Condition Factor of *C. gariepinus* Fry under different Bioshade condition

Growth Parameters	Treatments			
	USCP	WLCP	WHCP	TDCP
Final mean weight (g)	1.802±0.05[b]	2.34±0.03[a]	2.358±0.04[a]	1.381±0.02[c]
Initial mean weight (g)	0.04±0.01[a]	0.04±0.01[a]	0.04±0.01[a]	0.04±0.01[a]
Mean weight gain (g)	1.762±0.004[b]	2.309±0.02[a]	2.318±0.03[a]	1.341±0.01[c]
Mean weight gain (%)	4405±5[b]	5772.5±0.02[a]	5795±5[a]	3352.5. ±3[c]
Specific growth rate (g)	8.99±0.07[b]	9.69±0.03[a]	9.66±0.04[a]	8.38±0.03[c]
Condition factor	0.98±0.01[c]	2.13±0.03[a]	2.00±0.01[b]	0.72±0.01[d]

Means value with different superscript along the same row are significantly different ($p<0.05$)

Key: USCP=unshaded sunlight concrete pond, WLCP=water lettuce shaded concrete pond, WHCP =water hyacinth shaded concrete pond and TDCP= total darkness shaded concrete pond.

The result of the physico-chemical parameter of the experimental water:

Water temperature and pH in the treatment tanks ranged between 26.02-26.31^{o}C and 7.24-7.35, while total alkalinity, dissolved oxygen and carbon dioxide ranged between 15.10-15.15mg^{-l}, 7.10-7.11mg^{-l}, and 4.02-4.05mg^{-l}, respectively. There was no significant difference ($p>0.05$) in the physico-chemical parameter of experiment water as show in Table 2 below.

Table 2: Mean Water Quality Parameters of different treatment

Water Quality Parameters	Treatments			
	USCP	WLCP	WHCP	TDCP
Temperature (^{o}C)	26.11±0.02	26.03±0.04	26.02±0.02	26.31±0.04
PH	7.35±0.02	7.24±0.03	7.25±0.03	7.34±0.02
Total alkalinity (mg^{-1})	15.15±0.03	15.10±0.01	15.10±0.02	15.11±0.02
Dissolved oxygen (mg^{1})	7.10±0.02	7.11±0.03	7.10±0.02	7.11±0.02
Carbon dioxide (mg^{-1})	4.05±0.03	4.02±0.03	4.05±0.02	4.05±0.02

Survival rate of *C. gariepinus* fry exposed to different sunlight shaded condition.

The survival rate of fry was highest (89%) in WLCP and (81%) in WHCP. Lowest survival rate (57%) was recorded in USCP. The result indicated significant difference in survival rate among the treatments, Results is shown in figure 2 below.

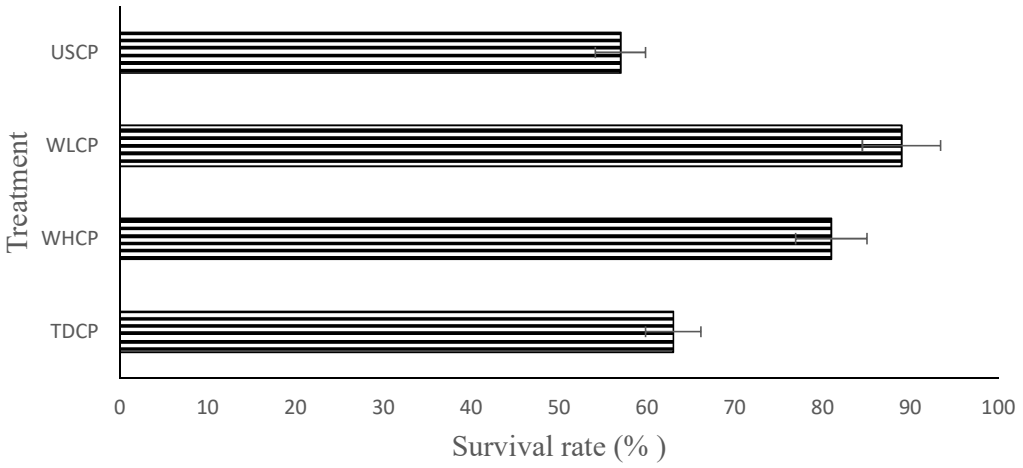

Figure 2: Survival rate of *Clarias gariepinus* fry under different sun light shaded condition

Discussion

The result of this study on the growth performance of *C. gariepinus* fry indicated that there was progressive increase in mean weight, % MWG and SGR of fry reared in WHCP and WLCP as compared to TDCP and USCP this was probably due to better feed conversion efficiency (Almazan-rueda *et al.,* 2005). The reduction of stress, as well as suppression of locomotory activities, and the biological covering that protect against predators, help enable conservation of more energy, which normally would have been expended on these metabolic activities to be converted to growth (britz and pienear 1992).

Okunsebor *et al.,* (2016) also reported that *C. gariepinus* fingerlings performed better in terms of growth performance, condition factor and survival rate under biological shades. Hecht and Appelbaum, (1992) reported that the provision of shelter and reduced light improved growth rate in both low and high light density treatment used on C. *gariepinus* fingerlings

The value of condition factor was found to be lowest (K=0.72+0.50) in TDCP regime. Luciano *et al.,* (2009) observed that condition factor of *Odentesthes orgentinensis* larvae reared was higher ($p<0.05$) Than larvae reared in dark at 12L:12D, they however concluded that significantly reduced growth and condition factor of fish larvae reared in the dark was due to reduced feed consumption as a result to lower encounter with prey.

The ranges of water quality parameters measured in the experiment were normal for culture of the fish species (Boyd 1979) and thus could not be implicated in the significant growth responses recorded in the four treatments. The temperature range recorded in the study 26.02-26.31^{o}C were within the range for optimum growth of *C. Gariepinus* fry, Boyd and Frobish (1990) observed that warm water fish grows best at temperature between 25 and 27^{0}C. The pH range of 7.24-7.35 recorded in the study falls within the recommended range of 6.5 -9.0 (Boyd and Lichtkopper 1979).

High survival rate was record in WLCP and WHCP compared to TDCP and USCP with significant difference ($P<0.05$) in survival rate among the treatments this agreed with the findings of (Appelbaun and Kamler 2000) who reported that survival rate of C. *gariepinus* juveniles was found to be suppressed by light but in contrast with Britz and pienaar (1992) who did not detect any difference in survival rate of *C. gariepinus* larvae reared for 13 days

in continuous dark or light, with or without cover, nevertheless they concluded that stress, aggression and cannibalism are reduced under dark conditions.

In conclusion water lettuce shaded tank and water hyacinth shaded tank enhance growth rates of fry as the survival rate of *C. gariepinus* fry was significantly higher in WLCP and WHCP hence the provision of shelter, biological shades and low light in hatcheries will likely benefit fry rearing facilities for *C. gariepinus*.

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