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Research Article

Effects of Water Level on Growth and Survival of *Clarias gariepinus* (Burchell, 1822) Fingerlings

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ABSTRACT

This study evaluated and compared growth performance and survival of *Clarias gariepinus* fingerlings cultured in different water level. The water level used was 0.8m (T1), 1.0m (T2) and 1.2m (T3). 120 *C. gariepinus* fingerlings of initial mean weight 3.45±0.00-3.75±0.00g was fed for 60 days twice a day (morning and evening) with commercial (Coppens) feed at 5% body weight and weighed fortnightly, the new weights were used to adjust the quantity of offered feed to the fish. Weight gain (WG), specific growth rate (SGR), feed conversion ratio (FCR), survival rate, etc., were determined fortnightly for each treatment. Data resulting from the experiment were subjected to one-way analysis of variance (ANOVA) at ($P<0.05$) significance level. The results shows that the highest (49.64g) weight gain was recorded in T3 followed by T2 (44.68g), and lowest (43.23g) weight gain of was obtained in T1. There were no significant differences ($P< 0.05$) among the treatment from one another. The highest (53.30g) final weight was obtained in fish, stocked in T3, followed by T2. The least (46.70g) final weight was recorded in T1. There were no significant differences ($P<0.05$) between the treatment. The least (1.74) feed conversion ratio was obtained in T2, followed by 1.60 T3, and lowest (1.35) value of feed conversion ratio was recorded in T1. It has been observed that, there was no significant differences ($P<0.05$) between the treatment. Water quality parameters indicate (Table 3) highest (7.85) pH value was recorded in T2 and the lowest (7.28) pH value was obtained in T1. There were no significant differences ($P<0.05$) between the treatment. The water temperature was higher (25.75) in T2 while the least (25.67^{0}C) was obtained in T3, there was no significant differences ($P<0.05$) between the treatment respectively. Therefore, it can infer that for optimal survival and growth of *C. gariepinus* fingerlings should be reared in water depth of 1.2m.

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INTRODUCTION

Catfish is the major fish cultured in Nigeria because it is found all over the Country, eaten by most tribes, resistant to harsh environmental conditions, commands good price, tasty and can be kept alive for days during marketing, estimates put the current production output of *Clarias gariepinus* in the country at over 253,898 metric tons per year (Anetekhai, 2013). *Clarias gariepinus* is generally considered to be one of the most important tropical freshwater fish species for aquaculture whose aquaculture potential have been documented (Dada and Wanah, 2003). FAO, (2012) reported that catfish species had long been regarded as one of the most suitable species for culture in Africa because of their hardy qualities.

Aquaculture continues to grow more rapidly than all other animal food-producing sectors in the world (FAO, 2006). Unlike terrestrial farming, where the bulk of the production is based on a limited number of species, aquaculture produces more than 220 species (FAO, 2012). Fish farming is particularly an important aspect of aquaculture as it provides about 40% of the dietary intake of animal protein and constitutes a third of the world's supply of fish products; it is lower in total fat and calories than meat or poultry, hence a healthy protein choice (Gramma *et al.*, 2011). Fish culture is considered one of the promising resources of animal proteins for the future (Persson, *et al.,* 1991). The contribution of fisheries to the nation economy is very significant in term of employment, income generation, poverty alleviation, foreign exchange earnings and provision of raw materials for the animal feed industry. The local supply of fish and fishery products consists of production from the artisanal (85%), industrial (14%) and Aquaculture (1%) subsectors (FAO, 2012).

Aquaculture production is primarily determined by availability of water for culture of different aquatic organisms. Many fish farming culture systems have been jeopardized due to non-availability of water for culture of fish (Flodmark *et al.,* 2004). Aquaculture production can be boosted through good site for construction of standard ponds, provision of quality feeds, quality water and management skills. Nevertheless, water level is a crucial factor that must be considered, as this determines the growth, survival, yield and the well-being of the fish. Several findings had been reported by researchers on the effects of water level on survival, growth, behavior of different fish species (Flodmark *et al.,* 2004). Fish and fisheries are an integral part of most societies and make important contributions to economic and social health and well-being in many countries and areas (FAO, 2006). Despite several studies been conducted on effects of water level on fish growth, little or no information has been documented on the water level required for culture of *Clarias gariepinus.*

MATERIAL AND METHOD

Study Area

The study was conducted in the fish hatchery unit of the Department of Fisheries on latitude 11^0 S' north and longitude 13^0S' east and at about 350m sea level, at the permanent site of University of Maiduguri, Borno state, The climate of Maiduguri is favourable, with a mean annual and temperature of about 650 mm and 32^0C respectively. The month of March and April are the hottest period of the year with temperature ranges between 30^0C and 40^0C, it is usually cold and dry during the hamatten, November to January being the coldest month (Google, 2013).

Experimental Design

A total of 120 *Clarias gariepinus* fingerlings were obtained from a Private hatchery in Maiduguri. The fish were transported in 50 liters jerry Can and acclimatized in the indoor hatchery ponds for two weeks before the commencement of the experiment. The fingerling was weight and randomly stocked. The experimental fish were stocked in to designated ponds as T1, T2, and T3 respectively**,** each treatment was replicated thrice at 10 fish per different level (0.8, 1.0 and 1.2 meter). The fish were fed for the period of 60 days twice a day (morning and evening) at 5% body weight and weighed fortnightly; the new weights were used to adjust the quantity of offered feed to the fish.

Water Quality Parameters

The following water quality parameters were monitored during the experiment fortnightly. Temperature was measured using mercury in glass thermometer, A pH meter was used to measure pH and Secchi disk was used to determine the transparency of the water.

Experimental Diet

2 mm pellets size of commercial feed (coppens) was used during the experiment and was stored in cold and dry place during the experiment.

Table 1: Proximate analysis of diet fed to *Clarias gariepinus*

Proximate chemical analysis	
Ash	9.5
Crude protein	45
Crude fiber	1.5
Lipid	12.0
Nitrogen – free extract	10.0

Growth Parameters

The following growth parameters were calculated based on the formula determine by (Ayoola *et al*, 2012)

i. MWG = W2 – W 1

Where: W2 = Mean final weight of fish

W1 = Mean initial weight of fish

ii. Specific Growth Rate (SGR) was calculated as: $\frac{(\text{Ln } W2 - \text{Ln } W1)}{T} \times 100$

Where: LnW2 = Mean final weight

Ln W1 = Mean initial weight

T = Time trial period

iii. Feed Conversion Ratio (FCR) = $\frac{\text{Weight gain by fish (g)}}{\text{Total feed consumed by fish (g)}}$

iv. PER = $\frac{\text{Body weight gain (g)}}{\text{Protein intake (g).}}$

v. Survival rate = $\frac{\text{number of fingerling at the end of the experimental period}}{\text{number of fingerling at the beginning of the experimental period}} \times 100$

Statistical Analysis

Data obtained were subjected to one- way analysis of variance(ANOVA) and LSD Test for the separation of means at a significance level (p<0.05).

RESULTS AND DISCUSSION

Table 2 shows the mean growth performance of *Clarias gariepinus* fingerlings stock at different water level in concrete ponds. The highest (49.64g) weight gain was recorded in T3 followed by T2 (44.68g), and lowest (43.23g) weight gain of *Clarias gariepinus* was obtained in T1. There were no significant differences (P< 0.05) among the treatment from one another. The highest (53.30g) final weight was obtained in fish, stocked in T3, followed by T2. The least (46.70g) final weight was recorded in T1. There was no significant differences (P<0.05) between the treatment. The highest (2.55) specific growth rate was achieved in T2, followed by T3. The lowest (2.27) specific growth rate was obtained in T1 (0.8 m). There were no significant differences (P<0.05) between the treatments The protein efficiency ratio was highest (1.09) in the fish stocked in T3, followed by T2.

The least (1.74) feed conversion ratio was obtained in T2, followed by (1.60) in T3, and lowest (1.35) value of feed conversion ratio was recorded in T1. It has been observed that, there was no significant differences (P<0.05) between the treatment. The condition factor (3.08) of the fish was higher in T2. There was no significant difference (P<0.05) between the treatment. The highest (90 %) survival rate was obtained in T3. The lowest (85.50%) survival of *Clarias gariepinus* was obtained in T1. There was no statistical difference (P<0.05) between the treatment.

Water quality parameters indicate (Table 3) highest (7.85) pH value was recorded in T2 and the lowest (7.28) pH value was obtained in T1. There was no significant differences (P<0.05) between the treatment. The water temperature was higher (25.75) in T2 while the least (25.67^{0}C) was obtained in T3. There was no significant differences (P<0.05) between the treatment. The highest (35.9m) transparency of the water was recorded in T1 and the lowest (45.67) observed in T3. There was no significant differences (P<0.05) between the treatment

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Table 2: Mean growth Parameters of *Clarias gariepinus* stocked at different Pond water levels.

PARAMETERS	**LEVEL OF DIFFERENT WATER DEPTH**			
	T1 (0.8 m)	**T2 (1.0 m)**	**T3 (1.2 m)**	**SEM**
IW (g)	3.45^{a}	3.75^{a}	3.67^{a}	0.16
FWG (g)	46.70^{a}	48.93^{a}	53.30^{a}	3.27
WG(g)	43.23^{a}	44.68^{a}	49.64^{a}	3.27
SGR(g/day)	2.27^{a}	2.55^{a}	2.41^{a}	0.21
FCR(g/day)	1.35^{a}	1.74^{b}	1.60^{a}	0.04
PER(g/day)	0.95^{a}	1.02^{a}	1.09^{a}	0.07
SR (%)	85.50^{a}	87.50^{a}	90.00^{a}	5.71
CF(k)	2.38^{a}	3.08^{a}	2.80^{a}	0.31

Mean on the same row having the same superscript are not significantly different (P < 0.05).

Key: IW= Initial Weight, FWG= Final Weight, WG= Weight gain, Specific Growth Rate, FCR = Feed Conversion Ratio, PER = Protein Efficiency Ratio, SR = Survival Rate, CF = Condition factor

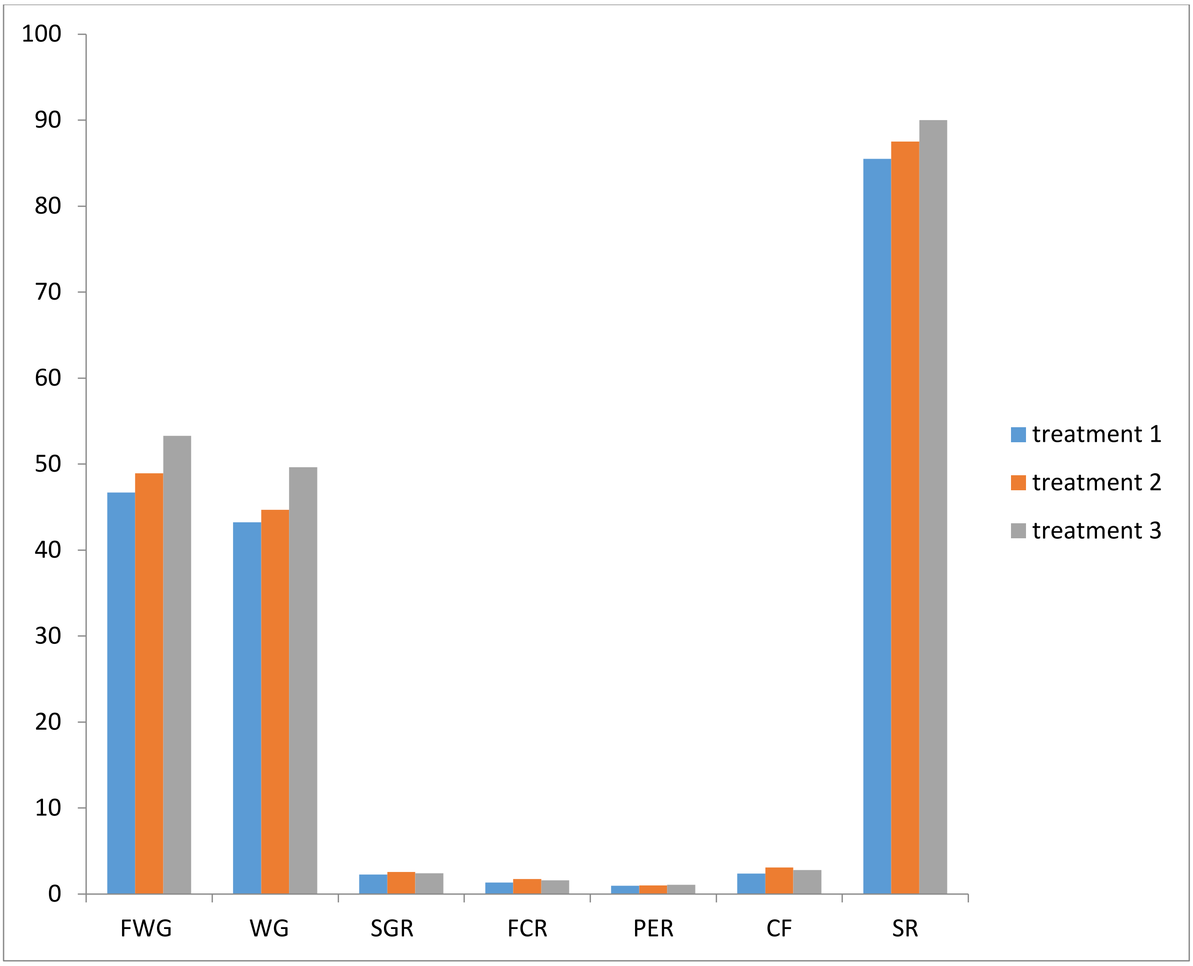

Figure 1: Growth performance of *Clarias gariepinus* fingerlings at different water levels

Table 3: mean water quality parameters of *Clarias gariepinus* stocked at different water level.

PARAMETERS	T1 (0.8 m)	T2 (1.0 m)	T3 (1.2 m)	SEM
pH	7.28[a]	7.85[a]	7.73[a]	0.27
Temperature (^{0}C)	25.70[a]	25.75[a]	25.67[a]	0.23
Transparency (cm)	25.9[a]	41.77[a]	45.67[a]	0.70

Mean on the same row having the same superscript are not significantly different (P > 0.05).

The parameters calculated for growth parameters as presented in table 2 shows highest (53.30g) mean final weight value obtained in the study is higher, than (27±25) reported by Mohamed, (2008). The variation may be attributed to the differences in the fish culture. The highest (49.63g) mean weight gain attained in this study is higher than (14.02g) recorded by Adebola and Adetunji, (2015) who study the effect of water level on growth and survival of *Clarias gariepinus*. The highest initial weight gain and mean weight gain values recorded in T3 were significantly higher (P<0.05) than other treatments. It has been observed that the, mean specific growth rate has the highest (2.55) value in T2 is close to 2.42 reported by Adebola and Adetunji, (2015) on growth and survival of *Clarias gariepinus*. The closeness may be due to the similarities in the water temperature recorded in the trail and the species used. However the Specific growth rate further indicated that there was no statistical variation (P<0.05) compared further treatment. The higher (1.74) feed conversion ratio is similar with the findings of Tijjani and Ajani, 2017 obviously, there was no significance variation (P<0.05) in T3 compared to other treatments, however, this finding is higher than (0.92) reported by Adebola and Adetunji, (2008). The protein efficiency ratio recorded in this study is similar to the findings of Tijjani and Ajani, (2017) who work on growth and digestibility of *Clarias gariepinus*. The value of Feed conversion ratio and Protein efficiency ratio obtained in this study, were efficiently achieved with increasing in water level in the ponds. This report was in line with the finding of Flodmark *et al.*, (2004) who reported that juvenile brown trout exposed to high stable water level showed higher feed intake and growth rate than those exposed to fluctuating or low water level. Likewise, it was observed that in this study mean weight gain, total weight gain and Specific growth rate increased significantly with an increasing water level from 0.8 meter to 1.2 meters. This may be attributed to the level of dissolved oxygen that also increases in water level. According to dahlbey *et al*., (1968) fish growth and feed intake were adversely affected by low dissolved oxygen.

The percentage survival rate recommended in this study was similar to the findings of Ali, (2013), the highest (90.00%) survival rate in this study was obtained at an increasing water level, transparency, PER, weight gain and final weight. The high survival rate in T3 which is the highest water level was attributed to the fish live in naturally in deeper water (Fig.1) which are in line with the findings of El-Sayed *et al.*, 1996, Olin 2002, Takashi 2003, Abd El 2008, Hofman 2008, Stoll *et al.*, 2008; Bhatnagar and Devi 2013.

The water quality may monitor to determine the quality of the water, growth as well as wellbeing of the fish. pH values recorded in this study range between 7.28 (T1) and 7.85 (T2). This finding is contrary with the report of Padapoli and Ramadu, (2014) and Ajiboye *et al.* (2015) the higher pH value in this study was within the tolerable level recommend for tropical fish aquaculture NAERLS 2000, Naselli 2000, IEPA 2001, Skelton 2003, Stone 2004, Isyiagi 2009, and Pedapoli 2014. The value recorded for pH was not significantly different (p< 0.05). The temperature recorded in this study ranges from 25.67 to 25.70^{0}C, the temperature obtained were not significantly difference (P<0.05) as temperature is one of the most important physical factors affecting fish growth as reported by Neill 1991, Iwama 2000, Dan and Little 2000; and Gabir *et al*., 2012. These findings are not in agreement with the findings of Singh and Santhosh (2007), who reported 24^{0}C to 30^{0}C this could be due to the difference in the culture media. The value of transparency reported in this study was attained with increased in water level. This finding agreed with the range of 40-80cm as an acceptable for fish culture according to Kubecka 1993, NAERLS 2000, Pivnicka 2001, Boyd 2003, Alam 2006, Ekubo 2011, LaDon 2011, and Keppeler 2012 indicated optimal planktons' production.

CONCLUSION

From the result of this study, it concludes that 1.2 meter water level in concrete pond is optimum for survival and growth of *Clarias gariepinus* fingerling culture and it is recommended that more research should be conducted on effect of water level on nutrient utilization of cl*arias gariepinus* fingerling.

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