



Research Article

Growth Performance of *Clarias Gariepinus* and *Clarias Anguillaris* Obtained from three Ecological Zones in Nigeria

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ABSTRACT

The growth performance was conducted using *Clarias gariepinus* and *Clarias anguillaris* obtained from 3 ecological zones namely; Argungu (*Clarias anguillaris*), New Bussa (*Clarias gariepinus*) and Yola (*Clarias gariepinus*) respectively, to evaluate the differences in survival and growth rates to have fast growing fingerlings for replenishing stock. Eight (8) weeks periods were taken to conduct this work using a semi-flow through a system of fish culture, under open shade containing 25 litres of plastic bowls filled with 20 litres of water, in which 20 fry each from the parental crosses and their reciprocals were randomly selected and stocked in each bowl of the 9 treatments with 3 replicates each. The growth was found to vary from each eco-zone which was highly significant ($P < 0.05$). Survival 70-90%, the highest mean weight gained was 106.7 ± 21.246 (NB♂ x YY♀) while the least was 45.5 ± 1.674 (AR♂ x YY♀) while the mean increase in length was 20.867 ± 0.664 (NB♂ x NB♀) and 16.467 ± 0.333 (NB♂ x AR♀) and New Bussa broodstocks are recommended for our fish farmers as they proved to have the basic potentials required in aquaculture.

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INTRODUCTION

Fish contains nutrients that are very important and enhance reproduction (Onyia *et al.*, 2015). More so, fish is a cheap source of protein that helps to provide enough fish food for our teaming population (Idris *et al.*, 2018). African catfish (*Clarias spp*) is the preferred cultivated fish in Nigeria, because of its acceptability by the majority of the consumers, it could be reared throughout the year, and the good quality flesh is highly acceptable (Ochokwu *et al.*, 2015). *Clarias gariepinus* can be cultured all year round. In Nigeria, fish culture has evolved steadily and cultured in concrete, fibre, and tarpaulin culture systems (Saidu *et al.*, 2021). The development of aquaculture has successfully gained prominence (Ochokwu *et al.*, 2016), as is an ancillary for the poor catch from the wild. Reproduction technique in fish is one of the factors that enhance the breeding performance during production (Ochokwu *et al.*, 2015).

According to Ali *et al.*, (2008), fish contains all the essential animal proteins available in the tropics. It supplies about 40% of the dietary ingestion of animal protein of the average Nigerian (FDF, 2007) and important constituent for animal feed, as well as a suitable source of raw materials for allied industries (Esu *et al.*, 2009). Furthermore, fish farming contributes to about one-third of the Gross Domestic Product (GDP) in Nigeria (Amao *et al.*, 2009), provides full-time employment opportunities to more than 12 million individuals, to about 3% of the active population in Nigeria and livelihood opportunity indirectly for 11 million people (Olagunje *et al.*, 2007).

The most cultured species in Nigeria include *Clarias anguillaris*, *Clarias gariepinus*, *Oreochromis niloticus*, *Cyprinus*

carpio etc; but the majority of fish farmers prefer *Clarias gariepinus* because of its adaptability to different environmental factors, and the market price. The production of *Clarias gariepinus* fingerlings through hormonal induction (hypophysation) started in Western Nigeria in 1973 and has increased to date (Iheke and Nwagbara, 2010).

Local fish production has not been able to meet the domestic demand in the country (Oladimeji, 2017) and has led to the continuation of a deficit in the demand-supply gap in the country. Ugwumba and Chukwuji (2010) opined that greater improvement in catfish production can be achieved with the development of innovations that will enhance catfish farming and the socio-economic benefits of catfish farmers that constrain utmost production.

MATERIALS AND METHODS

Study Area

The study was conducted in the fish hatchery Department of Fisheries, Teaching and Research farm, Modibbo Adama University Yola, Adamawa State, Nigeria. Modibbo Adama University is located on latitude 9.20-9.330longitude 12.30 – 12.500E and an altitude of 185.9m, with an average annual rainfall of about 759mm and with a maximum temperature of 39.70C. The wet season mostly starts from May through October, while the dry season runs through November and terminates in April. The driest months of the year are January and February when the relative humidity drops to 13% (Canback Global Income Distribution Database, 2014).

Experimental Design and Set-up

In this study, every treatment was a parental cross with three replicates each; in a completely randomized design (CRD), which comprised nine experimental units. Nine plastic bowls (25 litres water capacity) were used for the

experiment. Each experimental unit was stocked with 20 fries (three days old). Each bowl was filled with water up to 20 litres

capacity, using a flow through. Stocking density (20 fry/m²) for desirable growth and survival according to (Sahoo *et al.*, 2005).

Experimental Crosses

Table 1: Expression of generic combination

	AR♀	NB♀	YY♀
AR♂	AR♂x AR♀	AR♂xNB♀	AR♂xYY♀
NB♂	NB♂xAR♀	NB♂x NB♀	NB♂xYY♀
YY♂	YY♂xAR♀	YY♂xNB♀	YY♂x YY♀

KEY: ♂=Male broodstock, ♀= Female broodstock, AR= Argungu, NB= Newbussa,YY= Yola

Collection of Brood stocks

The brooders were collected from Yola (Geriyo-*Clarias gariepinus*), Kebbi (Argungu-*Clarias anguillaris*) and Niger (New Bussa - *Clarias gariepinus*) in Plastic containers after which they were conditioned for fourteen days in a 1.5 m x 1.7 m x 1.7 m Brooders' Holding Tank of the Fish Hatchery. Coppens commercial feed at 3% of body weight, 6.0 mm was fed to the broodstocks following the Standard Operation Procedure (SOP) of (Dada *et al.*, 2010).

Water Quality Management (WQM)

The water analyses were made from the twenty-seven different bowls stocked with 20 fries each on weekly basis. Water samples were taken close to beneath to avoid skewed results (Ehiagbonare and Ogunrinde, 2010).

The temperature of the water sample was determined using a 250 ml glass beaker and a mercury-in-glass portable thermometer at the fisheries Laboratory after sample collection from the site. The bulb of the thermometer was dipped into the beaker filled with a water sample and allowed to remain inside for 5 minutes before the reading was taken.

To determine the water pH value, samples were obtained using a digital pH meter model

JENWAY 3015 instrument. The pH meter was switched on and allowed to warm up for 10 minutes. It was standardized using buffer 7.0 and 10.0 solutions. The electrode was rinsed with distilled water, and blot dry with soft tissue. The electrode was then inserted in the sample water until the meter reading stabilized. Dissolve Oxygen was determined using a digital dissolve oxygen meter, model AVI-660. It was switched on and warmed for 10 minutes with the electrode calibration solution.

Feeding (FR)

Artemia nauplii and vital commercial feeds were used in the experiment for eight weeks. Feeding was done at four (4) hours intervals daily as follows: 9:00 am, 1:00 pm, 5:00 pm, and 9:00 pm at 5% body weight. Left-over feed was siphoned-out before each feeding, while the water volume was balanced after siphoning and data collection. About 90-100% recharge was made every day, and the bowls were gently wiped with soft absorbent to remove dirt from the medium to avoid blockage and contamination. Total recharging and washing of bowls were done on weekly basis.

Monitoring of Growth and Mortality (GMM)

Mortality rates were monitored on daily basis. Changes in weight and total length of fry were measured at seven days intervals. The initial total weight and total length of fish for each experimental unit were measured using a sensitive weighing scale and a measuring board calibrated in cm respectively. This was done by

Percentage Survival (PS)

To calculate the percentage of fry survival within the duration of the experiment (Odedeyi, 2007) were followed.

$$\text{Percentage survival (PS)} = \frac{\text{No. of fry that survived}}{\text{Total No. of fry that start the treatment in each bowl}} \times 100$$

Total No. of fry that start the treatment in each bowl

Percentage Weight gained (WG).

Adewolu *et al.*, (2008) was adopted to calculate the Percentage weight gain of fry within the period of this research as shown below.

$$\text{Percentage weight gain (PWG)} = \frac{W_2 - W_1}{W_1} \times 100$$

Where W_2 = final mean body weight and

W_1 = initial mean body weight.

Specific growth rate (SGR)

Specific growth rate of the fry in the period of experiment were determined as stated below (Adewolu *et al.*, 2008).

$$\text{Specific growth rate (SGR)} = \frac{\text{Log}_e w_2 - \text{log}_e w_1}{T_2 - T_1}$$

Where w_2 = final weight,

w_1 = initial weight,

Log_e = Natural log to base e, T_2 = Final weight in days,

T_1 = Initial weight in days.

Statistical Analysis.

Survival and Growth Data collected were subjected to one way analysis of variance

siphoning the fry into a bowl. To transfer the fry, a linen cloth was used and quickly put into a pre-weighed plastic bowl containing water. Randomly, the length in centimetres was obtained by collecting five (5) fry from each experimental unit, and the body length was measured.

(ANOVA), and means were separated using Least Significant Difference (LSD).

RESULTS

Table 2 shows the Mean increase in weight of three strains of *Clarias gariepinus*, *Clarias anguillaris* and their Reciprocal Hybrids.

NB♂ x YY♀ recorded the highest final weight, daily weight gain, percentage weight gain and

Specific Growth Rate among the reciprocals hybrids and the parental crosses. A significant difference ($P < 0.05$) was observed in the growth parameters within the genetic crosses as AR♂ x YY♀ recorded the lowest.

Table 2: Daily Weight Gained, Percentage Weight Gained and Percentage Specific Growth Rate (SGR). (Table 7) revealed that

Genetic crosses	Initial weight (g)	Final weight (g)	Weight gained (g)	Daily weight gained (g)	Percentage weight gained (g)	Percentage Specific Growth Rate (SGR)
NB♂ x NB♀	0.07	86.2	86.13	1.54 ^b	99.9 ^a	5.5 ^c
YY♂ x YY♀	0.05	67.2	67.15	1.19 ^d	99.9 ^a	5.6 ^b
AR♂ x AR♀	0.07	66.9	66.83	1.19 ^d	99.8 ^b	5.3 ^e
NB♂ x YY♀	0.06	106.7	106.64	1.9 ^a	99.9 ^a	5.8 ^a
NB♂ x AR♀	0.06	50.4	50.34	0.89 ^f	99.9 ^a	5.2 ^f
YY♂ x NB♀	0.07	71.8	71.73	1.28 ^c	99.9 ^a	5.4 ^d
YY♂ x AR♀	0.06	50.7	50.64	0.9 ^f	99.9 ^a	5.2 ^f
AR♂ x NB♀	0.06	63.0	62.94	1.12 ^c	99.9 ^a	5.4 ^d
AR♂ x YY♀	0.06	45.5	45.44	0.81 ^g	99.9 ^a	5.1 ^g

Significantly different are means with different superscripts ($P < 0.05$)

KEY: ♂=Male broodstock, ♀= Female broodstock, AR= Argungu, NB= New Bussa, YY= Yola

Table 3 shows the Mean increase in length of three strains of *Clarias gariepinus*, *Clarias anguillaris* and their Reciprocal Hybrids.

Table 3. NB♂ x NB♀ had the highest daily length gain and length increase while AR♂ x

NB♀ had the highest percentage length gain and Specific Growth Rate among the reciprocals hybrids and the parental crosses. A significant difference at (P<0.05) was expressed.

Table 3: Growth Parameters in Length of *Clarias gariepinus*, *Clarias anguillaris* and their Reciprocal Hybrids

Genetic crosses	Initial length (cm)	Final length (cm)	Length gained (cm)	Daily length gained (cm)	Percentage length gained (cm)	Percentage Specific Growth Rate (SGR)
NB♂ x NB♀	1.1	20.8	19.7	0.35 ^a	92.8 ^h	2.28 ^d
YY♂ x YY♀	0.9	18.3	17.4	0.31 ^c	95.0 ^c	2.32 ^c
AR♂ x AR♀	1.1	16.7	15.6	0.28 ^e	93.4 ^g	2.12 ^g
NB♂ x YY♀	1.1	20.4	19.3	0.34 ^b	94.6 ^d	2.26 ^e
NB♂ x AR♀	0.9	16.5	15.6	0.28 ^e	94.5 ^e	2.26 ^e
YY♂ x NB♀	1.2	18.3	17.1	0.31 ^c	93.4 ^g	2.11 ^h
YY♂ x AR♀	1.1	17.4	16.3	0.29 ^d	93.7 ^f	2.14 ^f
AR♂ x NB♀	0.9	20.3	19.4	0.35 ^a	95.6 ^a	2.42 ^a
AR♂ x YY♀	0.9	19.9	19.0	0.34 ^b	95.5 ^b	2.40 ^b

KEY:

♂=Male broodstock, ♀= Female broodstock, AR= Argungu, NB= New Bussa
YY= Yola

From Table 4, the highest weekly growth performance in weight was revealed in NB♂ x YY♀ (106.7±21.246^a) while AR♂ x YY♀ has the lowest of all the genetic crosses (45.5±1.674ⁱ). There was significant difference amongst the genetic crosses (p<0.05).

Best Weekly Mean Growth Performance in Length (Table 5) was found in a pure line crosses; NB♂xNB♀ (20.867±0.664^a) and NB♂ x AR♀ (16.467±0.033ⁱ) the lowest. There were significant difference (P<0.05) in all the genetic crosses.

Table 4: weekly mean growth performance in weight of *Clarias garipinus*, *Clarias anguillaris* with their reciprocals.

Genetic crosses	1 st Week	2 nd Week	3 rd Week	4 th Week	5 th Week	6 th Week	7 th Week	8 th Week
NB♂ x NB♀	0.07±0.0 ^b	0.057±0.707 ⁱ	3.067±0.145 ^a	10.9±0.635 ^a	25.767±0.895 ^a	45.6±0.702 ^a	66.067±0.376 ^b	86.2±0.115 ^b
YY♂ x YY♀	0.053±0.003 ^e	0.257±0.052 ^h	2.4±0.346 ^c	8.3±1.443 ^c	12.867±1.241 ^h	29.967±0.722 ^d	48.067±3.583 ^d	67.167±6.379 ^d
AR♂ x AR♀	0.07±0.0 ^b	0.307±0.203 ^f	3.067±0.145 ^a	6.767±0.26 ^d	14.667±0.203 ^f	26.5±0.173 ^f	38.367±0.549 ^h	66.733±16.869 ^e
NB♂ x YY♀	0.066±0.003 ^c	0.45±0.057 ^a	2.72±0.118 ^b	6.1±0.519 ^f	15.0±0.693 ^e	45.6±7.563 ^a	76.2±14.434 ^a	106.7±21.246 ^a
NB♂ x AR♀	0.063±0.003 ^d	0.323±0.008 ^e	3.067±0.125 ^a	5.667±0.088 ^g	14.567±1.299 ^g	26.5±1.328 ^f	38.467±1.357 ^g	50.4±1.386 ^h
YY♂ x NB♀	0.07±0.0 ^b	0.347±0.003 ^d	1.9±0.231 ^e	6.667±0.779 ^e	15.3±0.586 ^d	34.067±0.145 ^b	52.9±0.289 ^c	71.767±0.722 ^c
YY♂ x AR♀	0.667±0.003 ^a	0.427±0.061 ^c	2.367±0.491 ^d	4.9±0.346 ^h	17.367±3.667 ^b	28.467±3.319 ^e	39.567±2.973 ^f	50.7±2.656 ^g
AR♂ x NB♀	0.667±0.003 ^a	0.447±0.118 ^b	1.1±0.058 ^g	8.367±0.491 ^b	15.767±2.742 ^c	31.5±2.136 ^c	47.267±1.53 ^e	63.0±0.924 ^f
AR♂ x YY♀	0.063±0.003 ^d	0.267±0.008 ^g	1.4±0.058 ^f	4.5±0.404 ⁱ	11.267±3.319 ⁱ	23.0±1.848 ^g	34.767±0.376 ⁱ	45.5±1.674 ⁱ

KEY:

♂=Male broodstock,♀= Female broodstock,AR= Argungu, NB= New Bussa,YY= Yola

Table 5: Weekly Mean Growth Performance in Length (cm) of *Clarias gariepinus* and *Clarias anguillaris* with their Reciprocal Hybrids.

Genetic crosses	1 st Week	2 nd Week	3 rd Week	4 th Week	5 th Week	6 th Week	7 th Week	8 th Week
NB♂xNB♀	1.067±0.033 ^d	2.333±0.067 ^c	3.8±0.000 ^c	5.867±0.203 ^a	7.633±0.203 ^a	7.867±3.267 ⁱ	14.667±0.696 ^a	20.867±0.664 ^a
YY♂xYY♀	0.767±0.133 ^f	2.1±0.3 ^d	3.6±0.115 ^d	5.267±0.318 ^c	6.433±0.203 ^g	9.533±0.033 ^e	13.833±0.033 ^d	18.3±0.519 ^d
AR♂xAR♀	1.133±0.033 ^b	1.767±0.033 ^h	3.267±0.033 ^g	5.033±0.145 ^e	6.667±0.033 ^f	9.2±0.058 ^f	13.067±0.664 ^f	16.7±1.155 ^h
NB♂xYY♀	1.567±0.517 ^a	2.567±0.517 ^b	4.3±0.404 ^a	5.3±0.656 ^b	7.433±0.633 ^b	10.433±0.667 ^a	13.067±1.732 ^f	20.367±1.530 ^b
NB♂xAR♀	0.9±0.0 ^e	1.967±0.333 ^f	3.367±0.333 ^f	4.9±0.115 ^f	6.967±0.260 ^c	8.667±0.088 ^g	12.2±0.058 ^h	16.467±0.033 ⁱ
YY♂xNB♀	1.133±0.033 ^b	1.9±0.0 ^g	3.267±0.088 ^g	5.1±0.231 ^d	6.9±0.058 ^d	9.867±0.033 ^b	14.2±0.058 ^b	18.267±0.203 ^e
YY♂xAR♀	1.1±0.0 ^c	2.033±0.145 ^e	3.5±0.289 ^e	4.7±0.058 ^g	6.733±0.463 ^e	9.567±0.376 ^d	13.867±0.088 ^c	17.4±0.346 ^f
AR♂xNB♀	0.667±0.167 ^g	3.167±0.067 ^a	3.933±0.291 ^b	5.033±0.067 ^e	6.967±0.384 ^c	9.767±0.176 ^c	13.167±0.088 ^e	20.333±0.524 ^c
AR♂xYY♀	0.9±0.0 ^e	1.667±0.067 ⁱ	3.067±0.033 ^h	4.433±0.12 ^h	6.033±0.491 ^h	8.567±0.726 ^h	12.533±0.433 ^g	17.2±1.607 ^g

Means with the different superscripts are significantly different (p<0.05)

KEYS: ♂=Male broodstock, ♀= Female broodstock, AR= Argungu, NB= New Bussa, YY=Yola

Water Quality Management (WQM)

Table 6: The Mean values of three water quality parameters taken.

Genetic crosses	Dissolve Oxygen (mg/l)	pH	Temperature (°C)
NB♂ x NB♀	6.61	7.2	32
YY♂ x YY♀	6.62	7.3	32
AR♂ x AR♀	6.62	7.3	32
NB♂ x YY♀	6.62	7.2	32
NB♂ x AR♀	6.62	7.3	32
YY♂ x NB♀	6.62	7.3	32
YY♂ x AR♀	6.62	7.2	32
AR♂ x NB♀	6.62	7.3	31
AR♂ x YY♀	6.62	7.3	31

KEY:

♂=Male broodstock, ♀= Female broodstock, AR= Argungu, NB= Newbussa
YY= Yola

DISCUSSION

Percentage Survival of *Clarias gariepinus*, *Clarias anguillaris* with their reciprocals

From this study, a very high survival rate was recorded, which is in agreement with reports of other authors (Akinwande *et al.*, 2012) and Olurin and Aderibigbe 2006), that crossed *H. longifilis* and female *Clarias anguillaris*. The highest value recorded was 90% in almost all the genetic crosses and the lowest was 70%. The survival of the hatchlings was very successful and could be due to adequate feeding and good management.

According to Brenda and Riley (1981), the survival of hatchlings beyond the yolk sac stage depends on the availability of suitable food sources because they have no built-up in reserved food. The lower values obtained in NB♂ x YY♀ and NB♂ x NB♀ (70%) might be a result of stress from weekly sampling and

management at an early stage of hatching. Ndimele and Owodemide (2012) also reported lower survival rates of 50.6% and 44.0% in a study for hybrids which disagrees with the present study. Excellent survival rate (92%) of local strain *Clarias gariepinus* at the larval stage may be attributed to its hardiness and adaptation to the environment. Concerning Omeji *et al.* (2013) report, the effect of hybridization on the lower performance of survival is also affirmed by the report of other researchers (Ndimele and Owodeinde, 2012). Abubakar *et al.* (2013) obtained a lower survival rate of (35.9±4.32, and 70%) respectively for *Clarias gariepinus* hybrids. The lower survival rate in this study can be attributed to mortality resulting from weekly data collection stress since the fry was very delicate at this stage, which agrees with the findings of Abubakar *et al.* (2013).

Specific Growth Rate (SGR) of *Clarias gariepinus*, *Clarias anguillaris* with their reciprocals.

The results obtained currently in this work proved to be higher than that of Diyaware and Onyia (2014) who reported 0.47 compared to 2.11 in this study. The mean body weight and length in this study revealed a gradual increase in all the genetic crosses with significant improvement. According to Brown *et al.*, (2014), using an aquaculture flow-through system can lead to increases in mean weight than those held in a stagnant system, as it allows high-density fish production within a breeding environment and sufficient aerated water supply.

On the average daily length (cm) gained, the results obtained throughout the 56 days expressed no significant difference ($P > 0.05$), but showed a significant difference in daily weight gained.

The growth of the larvae monitored for eight weeks revealed a progressive growth among the genetic crosses at the early stage, as there was no significant difference in the SGR and RGR, which agreed with Abdul *et al.*, 2017, who recorded a similar growth rate after the feeding trial for 28 days, the same trend was also reported by Ndimele and Owodeinde (2012). However, Ikechukwu *et al.*, (2019) explained that the growth among the fishes treated with ovaprim and pituitary gland extract was not significantly different. There was a

difference in growth rate among the strains originating from different geographical locations.

Water Parameters

According to Bhatnagar and Singh (2010), a dissolve Oxygen level greater than 5ppm was essential to support good fish production, which agrees with the results in this study as the maximum dissolve Oxygen level recorded was 6.62ppm and the minimum of 6.61ppm. Dissolved Oxygen (DO) obtained also supported the values of 6.3mg/l-6.8mg/l as reported by Onyia and Ochoku (2016) which had 5.6 ± 0.4 - 7.8 ± 0.73 .

Higher hatching and survival rates were observed at this pH range in the previous studies reported by (Ariole and Okpokwasili, 2012). The pH level corresponded with the work of Santhosh and Singh (2007) that reported, a pH range for fish culture between 6.7 and 9.5, and that the ideal range was between 7.5 and 8.5 which agreed with the findings of the present study.

CONCLUSION

From this study, it was discovered that for better survival and growth rate, the strain from either zones of *Clarias gariepinus* and *Clarias anguillaris* but preferably New Bussa, could produce hybrid catfish of a better choice for fish farmers. Further studies are recommended with broodstock of suitable sizes from other ecological zones to produce a holistic approach.

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