INTRASPCIFIC HYBRIDIZATION OF (*Clarias gariepinus (*Burchell 1822) STRAINS FROM TWO ECOLGICAL ZONES OF NIGERIA.

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ABSTRACT

In this study, the intraspecific hybridization of *Clarias gariepinus* strains from two ecological zone of Nigeria namely: Nguru from Yobe state designated as (NG) and Argungu from Kebbi state designated as (AR) were evaluated based on the differences in the percentage fertilization, hatchability, survival and growth performance percentage, the fish were conditioned, fed and spawned in the Modibbo Adama University, Fisheries research farm; for the period of 8 weeks in a semi-flow through system, in the indoor hatchery using plastic bowls filled with 20 litres of water, the eggs and milt was cross fertilized, in which after hatching 20 fry each from the parental crosses and their reciprocals hybrids were randomly selected and stocked in each bowl of 4 treatments with 3 replicates each.High fecundity rate was recorded in AR♀ with 31,480 numbers of eggs while that of NG♂ with 21,300. This study revealed that the cross between AR♂ x AR♀ had the highest fertilization rate of (90%) and the least in both AR♂ x NG♀ and NG♂ x NG♀ with (70%) and there was no significantly between the two crosses (P> 0.005). The cross between AR♂ x NG♀ had the best hatchability rate (100%) while the least in NG♂ x AR♀ (88%). The cross between NG♂ x NG♀ had the best survival rate (71.4%) and the least in NG♂ x AR♀ (47.1%), highest mean weight gained was 59.7±0.15 (NG♂ x AR♀) while the least was 30.30±0.79 (NG♂ x NG♀) while the mean increase in length were 16.30±0.20 (NG♂ x AR♀) and least 12.46±0.25 (AR♂ x AR♀). The cross between (NG♂ x AR♀) is therefore recommended to the farmers for culture in order to achieved profitable production.

Keywords. Fertilization, Hatchability, Growth, Survival, and *Clarias gariepinus,*.

INTRODUCTION

In aquaculture, fish production can be improved upon by genetically improved fishes. The usual traditional method of growing genetically improved fishes has been through hybridization and selective breeding. In selection, the target could be qualitative and quantitative traits, there is therefore a need to boost its fingerlings production and increase its growth performance (Adebayo and Popoola, 2018).

Fish production through hybridization is an age long practice in Africa. Hybridization in African catfishes *Clarias gariepinus, Clarias*

anguillaris, Heterobranchus bidorsalis and *Heterobranchus longifilis* has been in practice in Africa (Adah *et al*., 2014). Hybridization has been used to improve fish, increase growth rate, manipulate fish sex, production of sterile fish, and improve flesh quality, increase semen volume, increase disease resistance, and environmental tolerance (Bartley *et al*.,2000) Hybridization is used to produce offspring that performs better than both parental species (positive heterosis).Hybridization is the generation of a new form of plant or animal either naturally or by human intervention through combining the genes of two different species or subspecies. Fish hybridization is when two different species, genera or families are crossed, crossing of the first filial generation, backcrossed or out crossed to give the hybrid of desired qualities. Fish hybridization is an essential genetic technique that removes undesirable characteristics while retaining the desirable ones**.**

Materials and Method

Study

The study was conducted in the fish hatchery of Department of Fisheries, Teaching and Research farm, Modibbo Adama University Yola, Adamawa State, Nigeria.

Collection of broodstocks

The brooders were collected from Yobe (Nguru), and Kebbi (Argungu) state in Plastic Jerry-cans after which they were acclimatized for two weeks in a 1.5m x 1.7m x 1.7m Brooders Holding Tank of the Fish Hatchery. The brooders were fed 6.0 mm Coppens, top and vital commercial feed at 3% of their body weight, following the procedure of (Dada *et al.,* 2010).

Experimental crosses. Table 1. The generic combinations carried out.

	AR♀	**NG**♀
AR ♂	AR ♂×AR♀	AR♂ × NG♀
NG ♂NG ♂ × AR♀	NG ♂ × NG♀	

KEY:

♂ = Male broodstock, ♀= Female broodstock, AR=Argungun, NG = Nguru

Broodstock injection

Ovulin (Synthetic hormone) was used for this study. A syringe is filled with the suspension and the injection was given at 0.5 ml per kg fish. The most common method of administering the hormone solution is by intra-muscular injection into the dorsal muscle (Akombo *et al.,* 2018).

Collection of milt

After the latency period of 8- 10 hours, the male brood stock was removed from the holding tanks, The whole testes were

removed and cleaned with fluffy material/tissue paper. Using the procedure of (Akombo *et al.,* 2018).

Egg collection and fertilization

The females were equally removed from separate tank and slight pressure was applied on the abdomen to extrude the eggs into a clean dry bowl, stripping from the head region towards the fish vent and the content of the testes (milt) was spilled on the eggs for fertilization (a drop of milt on each treatment),the eggs were spread on 8 cm X 8 cm incubation tray placed in labeled spawning troughs containing 10-20 liters of water in the hatchery with flow-through water system, at water temperature between 26 and 31 °C. Growth and survival were among the most important traits determining yield potential.

This was then calculated according Akinwande *et al,* (2012) and Adebayo and Popoola, (2018):

$$Percentage\ fertillization = \frac{Number\ of\ fertilized\ eggs}{Total\ Number\ of\ eggs} \times 100$$

$$Percentage\ hatchability\ = \frac{Number\ of\ hatclings\ (3\ days\ old)}{Total\ Number\ of\ eggs\ fertilized} \times 100$$

$$Percentage\ survival\ rate = \frac{Number\ of\ fry\ that\ survived}{Total\ No.of\ fry\ that\ starts\ the\ treatment\ in\ each\ bowl} \times 100$$

Weight gain (WG).

(Cheikyula and Ofojekwu, 2003; Adewolu *et al.*, 2018)

$$Percentage\ weight\ gain\ = \frac{W_2 - W_1}{W_1} \times 100$$

$$pecific\ growth\ rate\ (SGR\ = \frac{\log e\, W_2 - \log e\, W_1}{Culture\ days} \times 100$$

Water quality management

The water quality parameters such as temperature, pH, and dissolved Oxygen (DO) were observed on weekly basis throughout the experiment by the use of water test kit; thermometer, pH meter, and dissolved oxygen kit.

Data analysis.

Data collected on fertilization, hatchability, Survival and growth were subjected to one way analysis of variance (ANOVA), and means were separated using Least Significant Difference (LSD). to compare growth performance using SPSS (Statistical Package for Social Sciences) computer package.

RESULTS

Mean Fertilization, Hatchability and Survival of genetic crosses from different strains of *Clarias gariepinus* from Nguru and Argungu and their Reciprocal Hybrids

The mean fertilization, hatchability and survival of genetic crosses from different strains of *Clarias gariepinus* and their Reciprocal Hybrids (table 2), showed fertilization, hatchability and survival were highest in AR ♂×AR♀, AR♂ × NG♀**,** NG ♂ × AR♀, NG ♂ × NG♀ respectively.

Table 2: mean fertilization, hatchability and survival of genetic crosses from different strains of *Clarias gariepinus* and their Reciprocal Hybrids.

Genetic crosses	AR ♂×AR♀	AR♂ × NG♀NG ♂ × AR♀		NG ♂ × NG♀
%fertilization	90^{a}	70^{c}	85^{b}	70^{c}
%Hatchability	89^{c}	100^{a}	88^{d}	93^{b}
%Survival	61.1^{b}	64.3^{b}	47.1^{c}	71.4^{a}

Mean in the same column with different superscript were significantly different ($p<0.05$)

Growth performance

Growth Parameters (Weight in g) *Clarias gariepinus* from Nguru and Argungu and their Reciprocal Hybrids showed the highest value recorded in NG♂ x AR♀ (58.977g) at the end of eight weeks (figure 1). However, the Length gained was recorded highest in both AR♂ × NG♀ and NG♂ x AR♀ (99.900) in the eight week (figure 2).The daily weight gained was highest in NG♂ x AR♀ and followed by AR♂ x NG♀, AR♂ x

AR♀, and NG♂ x NG♀. There were significant differences ($p<0.05$) in the growth parameters among the experimental treatments. NG♂ x AR♀ had the highest Percentage Specific Growth Rate (SGR) followed by NG♂ x NG♀, AR♂ x NG♀ and AR♂ x AR♀ respectively.

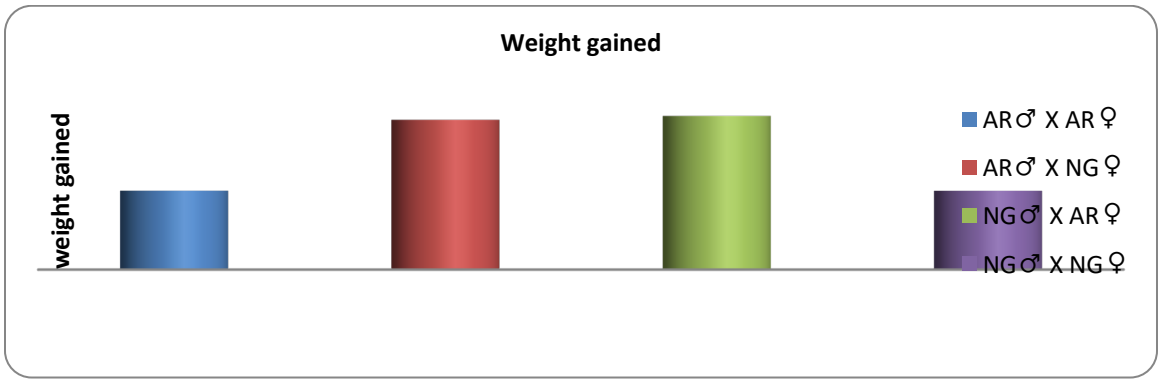

Figure 1. Percentage Weight gained of *Clarias gariepinus* and their reciprocals

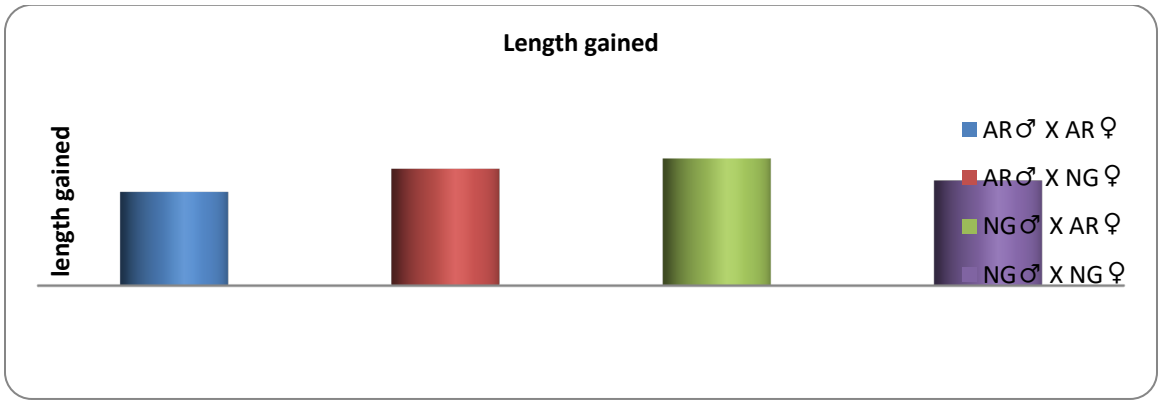

Figure 2. Percentage Length gained of *Clarias gariepinus* and their reciprocals

Table 3a: Growth performance of the hatchlings of four genetic crosses for eight weeks

Genetic crosses	Initial Weight(g)	Final Weight(g)	Initial Length(cm)	Final Length(cm)	MDWG (g/day)	SGR
AR ♂×AR♀	0.0467	30.333	1.267	12.46	70.543	4.960
AR♂ × NG♀	0.0667	57.570	1.500	15.467	1.027	5.203
NG ♂ × AR♀	0.0600	58.977	1.067	16.300	1.050	5.340
NG ♂ × NG♀	0.0467	30.253	0.967	13.533	0.537	4.977

Means values in the same column with different superscripts are significantly difference ($p<0.05$)

Key: MDWG = Mean Day Weight Gain, SGR = Specific Growth Rate

WATER QUALITY PARAMETER

Table 3b: The mean value of three Water quality Parameters taken for *Clarias gariepinus* from Nguru and Argungu and their Reciprocal Hybrids

Weeks	Dissolved Oxygen	Temperature	pH
Week 1	8.200±0.000[a]	30.333±1.607[c]	7.133±0.058[c]
Week 2	8.200±0.000[a]	30.000±0.000[e]	7.200±0.000[a]
Week 3	8.200±0.000[a]	30.833±0.764[b]	7.200±0.000[a]
Week 4	8.200±0.100[a]	30.333±0.76376[c]	7.133±0.058[c]
Week 5	8.167±0.058[b]	31.167±0.289[a]	7.167±0.058[b]
Week 6	8.067±0.116[c]	30.333±0.577[c]	7.067±0.116[d]
Week 7	8.200±0.000[a]	30.167±0.289[d]	7.067±0.116[d]
Week 8	8.167±0.058[b]	30.833±0.289[b]	7.133±0.058[c]

Means values in the same column with different superscripts are significantly difference ($p<0.05$)

DISCUSSION

The cross between AR♂ x AR♀ had the highest fertilization rate of (90%) and the least were recorded in both AR♂ x NG♀ and NG♂ x NG♀ with (70%) and are not significantly between the two crosses (P> 0.005). This is in partial agreement with the report of Akinwande *et al.,* (2012) that the highest percentage fertilization was recorded for parental crosses of *Clarias gariepinus* strains using Ovaprim synthetic hormone.

Also this study is incongruent with findings of Omeji *et al.,* (2013) who reported higher percentage fertilization among the purebreds and lower among the hybrids, after crossing exotic and local *Clarias gariepinus* strains.

The cross between AR♂ x NG♀ had the best hatchability rate (100%) while the least percentage hatchability was observed in the cross between NG♂ x AR♀ (88%). The percentage hatchability of the two *Clarias gariepinus* strains are presented in table 2. The hatchability varied significantly among the two strains (P< 0.005) in this study. However, the reciprocal hybrid had the best percentage hatchability than the parental crosses. The result in this study varied significantly with Olufeagba and Okomoda (2015) who report low hatchability rate

among the reciprocal hybrids (41.0%) compared with the parental crosses (94.0%).

Seasonal variation can also lead to differences in hatching rates as rightly observed by Shah *et al.,* (2011) and Ochokwu *et al.,* (2015). The result in this study partially agree with Olufeagba *et al.,*(2015) that a lower hatchability rate as rightly observed.

The cross between NG♂ x NG♀ had the best survival rate (71.4%) while the least percentage survival was observed in the cross between NG♂ x AR♀ (47.1%). which agree with the findings of Akinwande *et al.,* (2012) after crossing *H. Longifillis* 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.

The percentage survival of the two *Clarias gariepinus* strains are presented in table 2. The survival rate varied significantly among the two strains in this study. However, the purebred of NG♂ x NG♀ had the highest survival rate (71.4%) while the least percentage survival was observed in the cross between NG♂ x AR♀ (47.1%) hybrid crosses.

The findings in this research agree with that of Abubakar *et al.,* (2013) who reported low survival rate of (35.9±4.32, and70%) respectively for *Clarias gariepinus* hybrids.

The survival rate of hatchlings was very successful and could be due to adequate feeding and good management.

The results obtained in this study were higher than the one reported by Diyaware and Onyia (2014), but agree with Adebayo, (2017), that hybrid catfish had the fastest growth rate and showed better feed conversion ratio. The mean body weight and length in this study revealed a gradual increase in all the genetic crosses with significant difference. According to Brown *et al.,* (2014), using an aquaculture flow through system can lead to increases in mean weight than those held in stagnant system, which was proven in this work.

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

The dissolve Oxygen level was greater than 5mg/l and essential to support good fish production, which agrees with the results in this study as the maximum dissolve Oxygen level recorded was 8.2mg/l. Dissolved

Oxygen (DO) obtained also supported the values of 7.50mg/l-7.8mg/l as reported by Onyia and Sajo (2018).

The pH level corresponded with the work of Onyia and Sajo (2018) reported that, a pH range for fish culture between 7.0 and 7.5, and that the ideal range was between 7.5 and 8.5 as above or below might be stressful to fish.

Temperatures taken during this work agree with Onyia and Sajo (2018), with a tolerable range of 30-35^{0}C. Likewise Bhatnagar *et al.,* (2010) suggested that the level of temperature range of 28-32^{0}C would be good for tropical *Clarias gariepinus*.

CONCLUSION

The cross between AR♂ x AR♀ had the highest fertilization rate of (90%) while in percentage hatchability the cross between AR♂ x NG♀ had the best hatchability rate (100%). The parental cross between NG♂ x NG♀ had the best survival rate while in terms of specific growth rate, the hybrid cross of NG♂ x AR♀ had the highest growth in weight while the hybrid cross between NG♂ x AR♀ had the highest growth in length. From the results from this study, it is recommended that the hybrid(NG♂ x AR♀) should be cultured by farmers to maximize their profit.

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