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# Studies on hatching rates of *Clarias gariepinus* eggs on different substrates

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**Abstract**
Study on hatching rate of *Clarias gariepinus* eggs on different substrates was carried out at the hatchery section of the National Institute for Freshwater Fisheries Research New Bussa, Nigeria. The experimental broodstocks consisted of 6 females and 3 males and they were sourced locally. The substrates for the study were spawning mat, spawning net with sieve, and Kakaban; and they were assigned into three treatments, each replicated three times in a completely randomized design; spawning mat was labelled as T1, spawning net with sieve as T2, and Kakaban was labelled as T3. The result of the experiment showed significant difference with respect to Fertilization and hatching rate with highest value obtained for T1 (79.33±4.04), (76.00±5.29) and T2 (72.00±3.61), (66.33±8.08) respectively compared to T3 (62.00±7.21), (57.33±2.52). However, no significant difference was observed with respect to growth performance between the treatments. Based on the findings of this study therefore, spawning mat is recommended to be the best artificial substrate for incubation of *C. gariepinus* eggs.

**Keywords:** hatching, *Clarias gariepinus*

## Introduction

Aquaculture production has become more and more intensive, which may be as a result of production from capture fisheries reaching its maximum possible potential, as well as catch per unit effort dwindling with each passing day (Gabriel *et al.*, 2007) [6]. The success, or otherwise of aquaculture enterprise mostly depends on the supply of fish seed for on growing to market size (Rottmann *et al.*, 2003). The rearing of the larvae to the fry stage is the most critical aspect in the cycle of fish seed production in the hatcheries, therefore, the rearing of the larvae under controlled hatchery condition requires the development of culture techniques. Reproduction techniques are some of the factors that affect performance of any fish farm as it can be natural or artificial (Olanyi and Akinbola 2013) [10]. On a global perspective, it is one of the fastest growing food-producing sectors and fish is among the most traded food commodities accounting for 17 percent of worldwide intake of animal protein (FAO, 2014) [5]. Catfish is very important to the sustainability of the aquaculture industry in the country. *Clarias gariepinus* is one of the most important aquaculture species in Africa. Claridae family is very common in Africa and ranges from North Africa, through to the mid-Sahara and covering both East and West down to the South of the continent (Teugels, 1986) [14].

Aquaculture in Nigeria is still in the developing stage since it has still not been able to bridge the wide gap between demand and supply of the always increasing population in the country (Solomon *et al*., 2010) [13]. The catfish is very important to the sustainability of the aquaculture industry in the country. Catfish seed production has varying degree of success due to the high mortality of eggs and larvae (Clay, 1977; Msiska, 1981; Hogendoorn, 1990) [3, 7].

However, breeding failure has been attributed to biological (broodstock size and age, strain and species) and environmental (dissolved oxygen, pH, temperature, stocking density, photoperiod etc.) factors (Ataguba *et al.*, 2012; Ataguba *et al.*, 2013) [2, 1]. To mitigate these low hatching problems, research has focused on the suitability of the environment and biological factors as it affects breeding success. Several works were carried out by different researchers on improving the hatching rate of fish seeds production using different substrates with varying degrees of success (Olubiyi, *et al.* 2005; Solomon, *et al.* 2015; Macharia, *et al* 2005; Johua, 2004) [12, 8]. This research work therefore, was carried out to examine the hatching rate of eggs of *C. gariepinus* on different substrates in order to evaluate which of these substrates is the best to be used by hatchery operators and fish farmers.

## Materials and methods

### Study area

The study was conducted at the hatchery complex of National Institute for Freshwater Fisheries Research (NIFFR), New Bussa, Niger State, Nigeria. Broodstocks of *C. gariepinus* were sourced locally.

**Selection of breeders**

The experimental broodstocks consisted of 6 females and 3 males. The mature females were selected based on their swollen, reddish vent, well distended soft abdomen, and extraction of few eggs on gentle running of finger on the abdomen. Ripe males were selected based on their reddish urinogenital papilla.

**Injection of breeders and collection of eggs and milt**

The female fish were injected with ovaprim hormone using the manufacturer's recommended dosage of 0.5ml/kg. After injection, the fish were kept in closed containers in order to achieve latency. The females were stripped of eggs following a gentle pressing of finger on the abdomen after 12 hours latency period. While pressing the abdomen gently, the eggs were collected into a clean, dry, labelled container and kept according to treatments. Milt was collected by sacrificing the male the testes of the male were cut open using razor blade and the milt was squeezed out. The milt was used to fertilize the eggs. The fertilized eggs were spread on the substrates meant for the investigation.

**Experimental design**

The substrates for the study were spawning mat, spawning net with sieve, and Kakaban. The substrates were assigned into three treatments, each replicated three times in a completely randomized design; spawning mat was labelled as T1, spawning net with sieve as T2, and Kakaban was labelled as T3.

**Hatching rate and growth performance**

The substrates were evaluated for hatching successes and suitability in screening hatched from un-hatched egg in set of well aerated bowls for easy assessment of hatching rate. On the fourth day of hatching, the fry were fed with zooplankton and artemia for the first two weeks, and fry were randomly distributed into duplicate tanks of the same dimension (2m x 2m) at the outdoor section of the hatchery complex. The feeding was carried out for eight (8) weeks. Every week the weight of the fishes was measured in order to assess the productivity for each treatment so as to ascertain which of the treatments give optimal production.

**Data collection**

**Breeding performance**

Fertilization rate was determined using the following formula;

$$\text{Fertilization Rate (\%)}: \frac{\text{Number of fertilized eggs}}{\text{Total number of eggs collected}} \times 100$$

The hatching rates were calculated as follows;

$$\text{Hatching rate (\%)}: \frac{\text{Number of hatched eggs}}{\text{Total number of eggs fertilized}} \times 100$$

The percentage larval survival rates were then calculated thus;

$$\text{Larval survival rate (\%)}: \frac{\text{Total number of larvae - Number of dead larvae}}{\text{Total number of larvae}} \times 100.$$

**Growth performance**

Mean weight gain (MWG) of the fish was determined as the difference between final weight gain and initial mean weight. Specific Growth Rate (SGR) was determined from in $(W_2\text{-}W_1)/(t_2\text{-}t_1)$. Where $W_2$ and $W_1$ are final weight and initial weight respectively; t is time of the experiment.

Survival rate (%) = final number of fish/initial number of fish x 100

**Results and discussion**

Artificial breeding of *C. gariepinus* on different substrates was successfully carried out. The result as presented in Table 1 showed the growth parameters - initial weight, spent weight, egg weight, spawning fecundity, relative fecundity, and larval survival rate of the treatments showed no significant difference ($p>0.05$) in all the treatment means observed, while hatching rate and fertilization rate showed significant difference in T1 and T2. Fertilization and hatching rate were observed to be highest in T1 (79.33±4.04), (76.00±5.29) and T2 (72.00±3.61), (66.33±8.08) compared to T3 (62.00±7.21), (57.33±2.52) respectively. This position is also supported by Ataguba, *et al* (2013) [1] who reported significant difference in fertilization of eggs from different broodstock combinations by weight. Tiamiyu *et al* (2015) [15] also reported significant differences in fertilization of eggs from broodstocks administered serially diluted ovaprim hormone with saline water and coconut water. This, therefore, means that differences in fertilization are largely a result of biological characteristics of fish used to spawn hence the wide differences in the fertilization recorded. The initial weight (g) of *C. gariepinus* was highest in T1 with mean value of (800.00±150.00) while lowest mean value in T3 (700.00±86.60), also spent weight (g) was highest in T1 (700.00±150.00) and lowest in T3 (616.07±76.38), while egg weight was highest for T3 (83.33±28.87) and lowest weight in T1 (100.00±0.00), fertilization rate was highest in T1 (79.33±4.04) and lowest in T3 (62.00±7.21). Hatching rate was also highest in T1 (76.00±5.29) and lowest in T3 (57.33±2.52). This result agrees with Solomon *et al* (2015) [12] who reported hatching rate to be higher in eggs incubated on PVC frame with fine mesh net (79.40%) and lowest in eggs in the control treatment (20.70%), this may largely be due to higher screening efficiency recorded for the substrate compared to other substrates while larval survival rate was highest in T1 (57.67±2.52) and lowest in T3 (54.00±3.61). the result also showed that spawning fecundity was highest in T1 (88100±1000) and lowest in T2 (58166±14835) and relative fecundity was highest in T2 (30048.81±51919.26) and lowest in T3 (112.63±20.2).

Table 2 shows the outdoor growth parameters of initial weight, initial number, final weight, final number, mean weight gain, specific growth rate and survival rate, which showed significant differences ($p<0.05$) in each of the treatments. Final weight of the fish was observed to be highest in T2 (25.13±2.01) and lowest in T3 (12.16±0.29) while T3 (11.49±0.56) had the highest value of specific growth rate, compared to T1 (11.13±0.01) and T2 (11.11±0.40) respectively. The highest mean weight gain of 25.09±2.01 was observed in T2 and lowest in T3 (12.16±0.29). T3 in this experiment had highest value for survival rate (40.83±3.21) compared to T2 (36.17±2.47) and T1 (30.33±1.04) respectively.

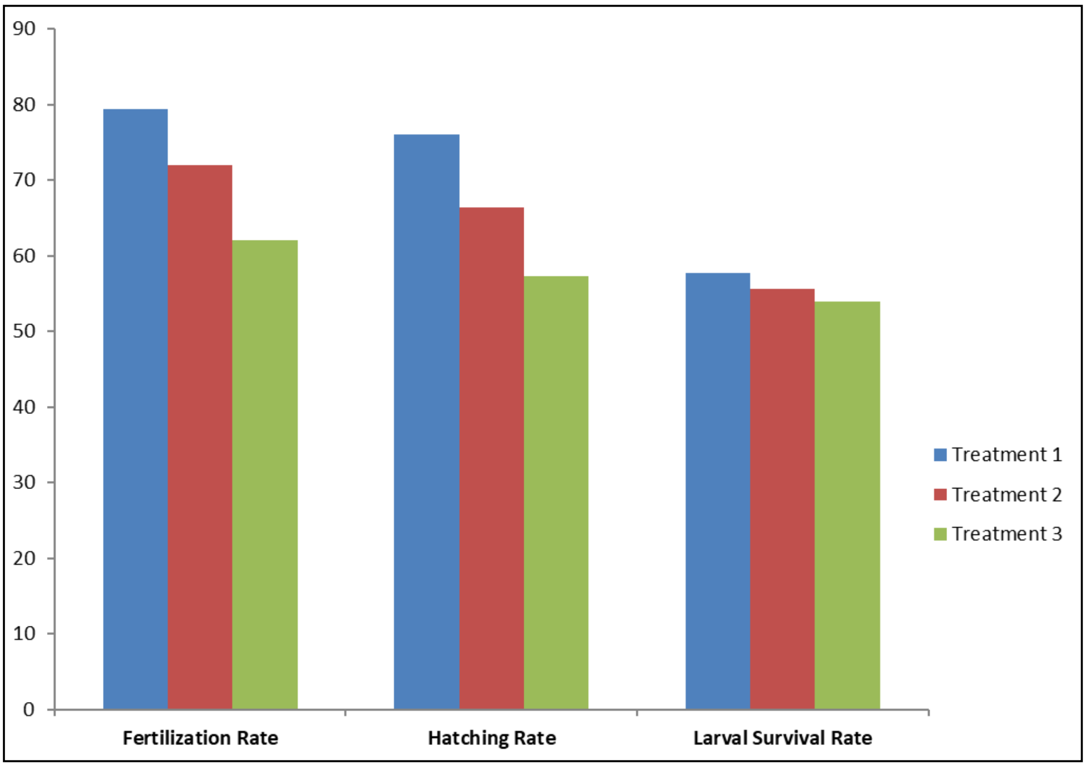


**Fig 1:** Breeding performance pattern of the experimental fish

**Table 1:** Breeding performance parameters of *C. gariepinus* eggs on different substrates

| Parameters | Treatments | | |
|---|---|---|---|
| | T1 | T2 | T3 |
| Initial weight(g) | 800.00±150.00$^a$ | 733.33±57.74$^a$ | 700.00±86.60$^a$ |
| Spent weight(g) | 700.00±150.00$^a$ | 656.67±40.42$^a$ | 616.07±76.38$^a$ |
| Egg weight(g) | 100.00±0.00$^a$ | 76.67±25.17$^a$ | 83.33±28.87$^a$ |
| Fertilization rate (%) | 79.33±4.04$^a$ | 72.00±3.61$^a$ | 62.00±7.21$^b$ |
| Hatching rate (%) | 76.00±5.29$^a$ | 66.33±8.08$^{ab}$ | 57.33±2.52$^b$ |
| Laval survival weight(g) | 57.67±2.52$^a$ | 55.67±3.51$^a$ | 54.00±3.61$^a$ |
| Spawning fecundity | 88100±1000$^a$ | 58166±14835$^a$ | 60000±18027$^a$ |
| Relative fecundity | 112.63±20.2$^a$ | 30048.81±51919.26$^a$ | 20577.25±35473.05$^a$ |

Means with similar superscripts on the same row are not significantly different ($p>0.05$)

**Table 2:** Outdoor growth performance parameters of *C. gariepinus*

| Parameters | Treatments | | |
|---|---|---|---|
| | T1 | T2 | T3 |
| Initial weight (g) | 0.04±0.00$^a$ | 0.04±0.01$^a$ | 0.04±0.01a |
| Initial number | 200 | 200 | 200 |

| | | | |
|---|---|---|---|
| Final weight (g) | 16.13±13[b] | 25.13±2.01[a] | 12.16±0.29[c] |
| Final number | 60[b] | 72[a] | 81[a] |
| MWG | 16.10±0.13[a] | 25.09±2.01[a] | 12.16±0.29[c] |
| SGR | 11.13±0.01[a] | 11.11±0.40[a] | 11.49±0.56[a] |
| Survival rate (%) | 30.33±1.04[b] | 36.17±2.47[a] | 40.83±3.21[a] |

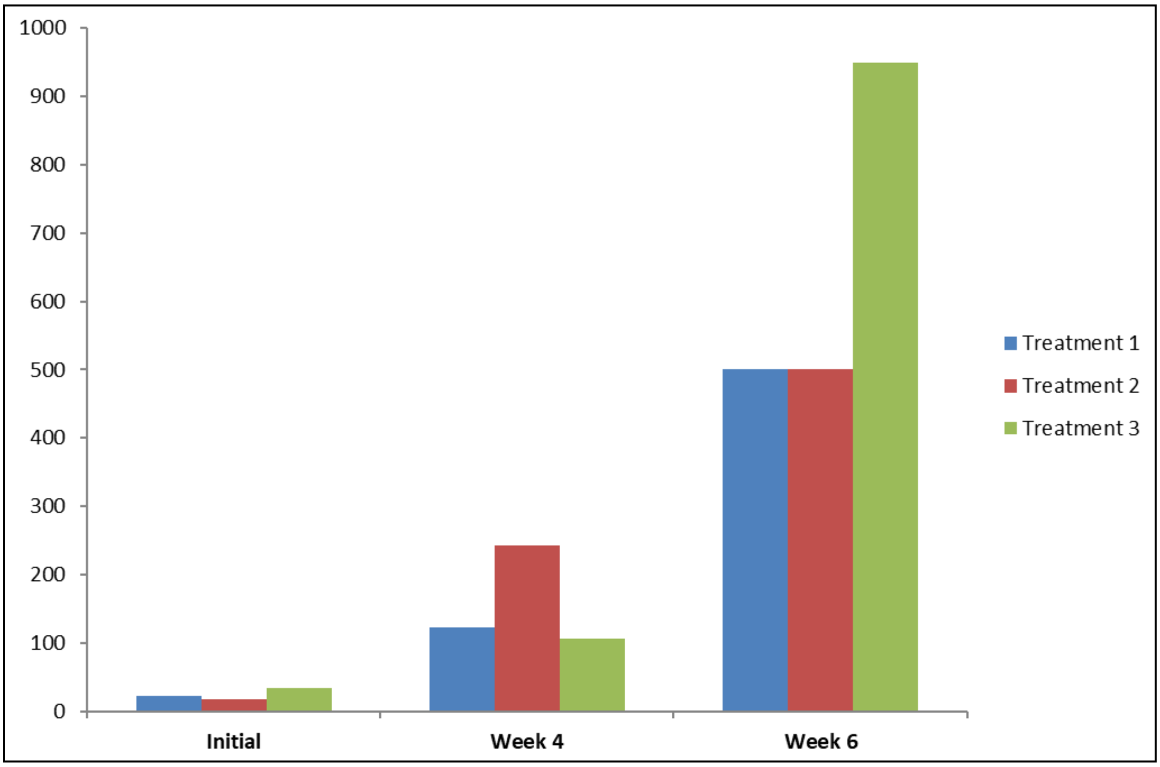


**Fig 2:** Total weight of the experimental fish

## Conclusion

The result of this study showed that there were significant differences (p<0.05) between the treatment means in terms of fertilization and hatching rate. However, all growth performance parameters observed (i.e., mean weight gai, final weight, specific growth rate, and survival rate) showed no significant difference (p>0.05) between the treatment means. Treatment 1 (i.e., spawning mat) was observed to have better growth performance than Treatment 2 (i.e., spawning net with sieve) and Treatment 3 (Kakaban) which has the least growth performance. Based on the findings of this study therefore, spawning mat is recommended to be the best artificial substrate for incubation of *C. gariepinus* eggs.

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