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Research Article

Effect of broodstock interruption on zootechnical performance of *Oreochromis niloticus fry*

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Abstract: The present study evaluated the performances of two larval production techniques of *Oreochromis niloticus*. The experiment was conducted on two batches of broodstock, a two-week-fed (G1) and a one-week (G2) batch reproduced separately in two 400-m^2 ponds containing five (5) happas of 10 m^2 each. Each happa contained 20 males for every 60 females. Fifteen (15) days after loading, the larvae and eggs were harvested and quantified. The amount of larvae produced by G2 spawners (1274 larvae + 13595 eggs) was higher than that obtained with G1 spawners (6770 larvae + 52 eggs). The rest of the test was carried out in six (6) aquariums of 200 liters each with larvae with an average weight of 0.027 ± 0.012 g (G1) and 0.015 ± 0.001 (G2). The final average weights observed were 2.05 ± 0.538 g (G1); 1.39 ± 0.365 g (G2). The nutrient quotients were 1.22 ± 0.327 (G1) and then 1.76 ± 0.386 (G2). Survival rates were 53.33 ± 21.939% (G1); 40.67 ± 6.766% (G2). According to our results, the larval production technique used in G1 broodstock could be used to produce quality larvae for a better profitability of production than that used for G2 broodstock.

Keywords: tilapia, broodstock, production technique, larvae, performance.

1. INTRODUCTION

Fish is the primary source of animal protein for people in developing countries [1, 2]. However, coverage of household fish needs in Africa is still difficult because of the lack of fish products, as a result of over-exploitation of fish stocks. Stocks of aquatic natural resources [3]. FAO [4] believes that in the face of this shortage of fish, fish farming appears as an alternative to increase production. In this context, several countries have initiated a development policy for fish farming, particularly that of tilapia (*Oreochromis niloticus*). However, a constraint of limited availability of fry hinders the development of the culture of this species[5] and this is mainly due to the lack of control of larval rearing which causes a high mortality rate. In fact, sustainable fish production depends on mastering the production techniques of the larvae of the species concerned in order to produce efficient fry with good growth potential. It is known that brood feeding is of paramount importance to the profitability of production. Thus, according to Abdelhamid *et al*. [6] the control of the production of fry stems, in large part, from the optimization of the conditions of management of the units of the spawners concerning the food aspect. The reduced potential of reared fry would be linked to the absence or mismanagement of broodstock [7,8.] . Although the basic techniques of raising *O. niloticus* from larval to market size are being mastered, there is still a need for accurate knowledge of broodstock management to produce quality fry. Indeed, fish farming is currently barely conceivable without the mass propagation of quality eggs and fry species. Therefore, we propose to study the performance of two techniques of fry production of *Oreochromis niloticus* from two lots of broodstock fed on two different periods (a lot fed over two weeks and the other on one week), with a view to improving the production of *O. Niloticus.*

2. MATERIALS AND METHODS

2.1. Conduct of the test: The experiments were conducted at the National Agricultural Research Center (CNRA) of Bouaké at the Research Station on Continental Fisheries and Aquaculture (SRPAC) between parallels 7 ° 38'6.68 "and 7 ° 37'49, 59 "north latitude and meridians 5 ° 2'26.47" and 5 ° 2'35.04 "west longitude (**Figure 1**).Cleaning and liming operations were carried out in the two pond structures (B1 and B2) of 400m2 each one week before loading. Before breeding, broodstock (males and females) were rested for 10 days. After this period, loading was done randomly in 10 happas of 10m² each due to 5 happas per pond **(Figure 2).** Each happa contained 20 males per 60 females at a sex ratio of 1 male to 3 females with a loading density of 8 ind / m². These broodstock were weighed individually using a TANITA KD 200 portable electronic scale (maximum weight = 1000 g and accuracy 1 g) The average weight for the test was 177 ± 50.37 g for males and 86 ± 25.03 g for females. These broodstock were separated into two batches and fed on two different periods (one batch was fed over two weeks and the other over a week) to IVOGRAIN feed at 5% of the total biomass, with a feeding frequency of twice a day (9 am in the morning and 3 pm in the afternoon). The food was distributed daily except for days of handling (loading, harvesting of larvae and eggs). On the 15th day after spawning, the larvae and eggs were harvested with a mesh net. Then a mesh net of 14 mm was used to recover the parents. In the case of female genitals, they were searched by mouth in washing machines. The larvae and eggs taken by happa were transferred to the hatchery, weighed and quantified. Then the eggs were incubated for further trials on the station. As for the larvae, they were sorted at the hatchery by means of a 3 mm mesh grid of rectangular shape, in order to select larvae of uniform sizes (≤ 12 mm total length) for the rest of the year. 'test. Larvae harvested from the production units were

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deposited inside the wire mesh for separation. Larvae at the desired size (≤ 12 mm) were able to pass through the mesh of the mesh, while the others of a length greater than 12 mm were retained.

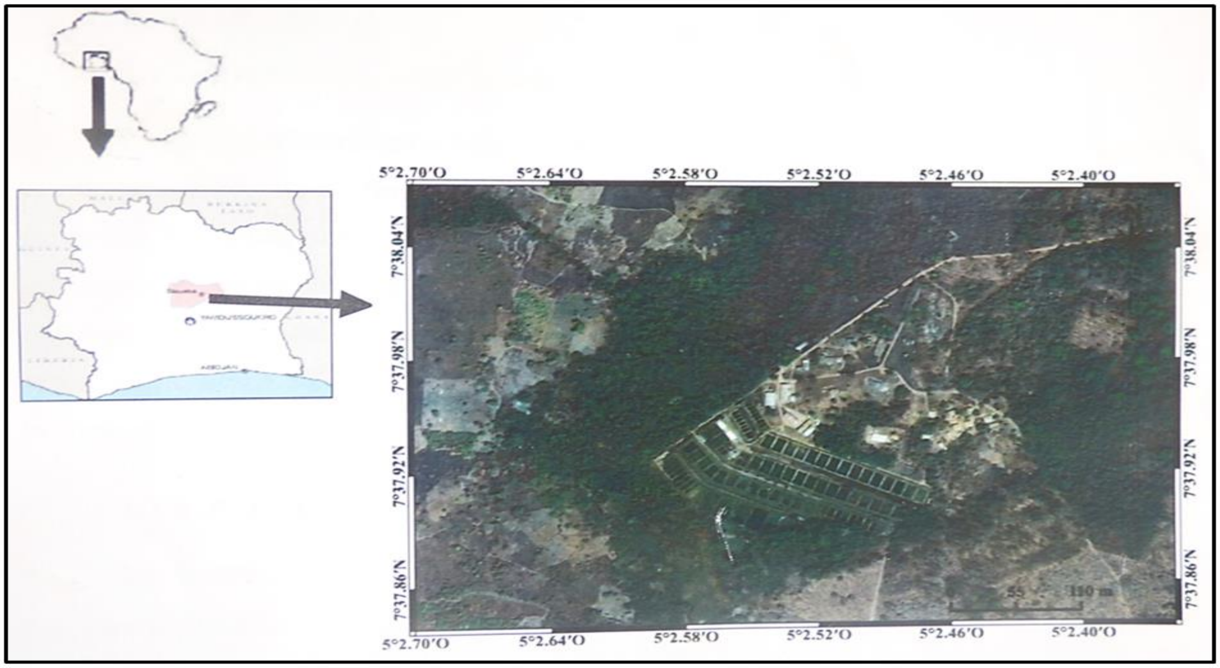

Figure 1: Satellite view of the Research Station on Inland Fisheries and Aquaculture of the National Center for Agronomic Research of Bouaké, Côte d'Ivoire (Google Earth, satellite image of 21/02/2016).

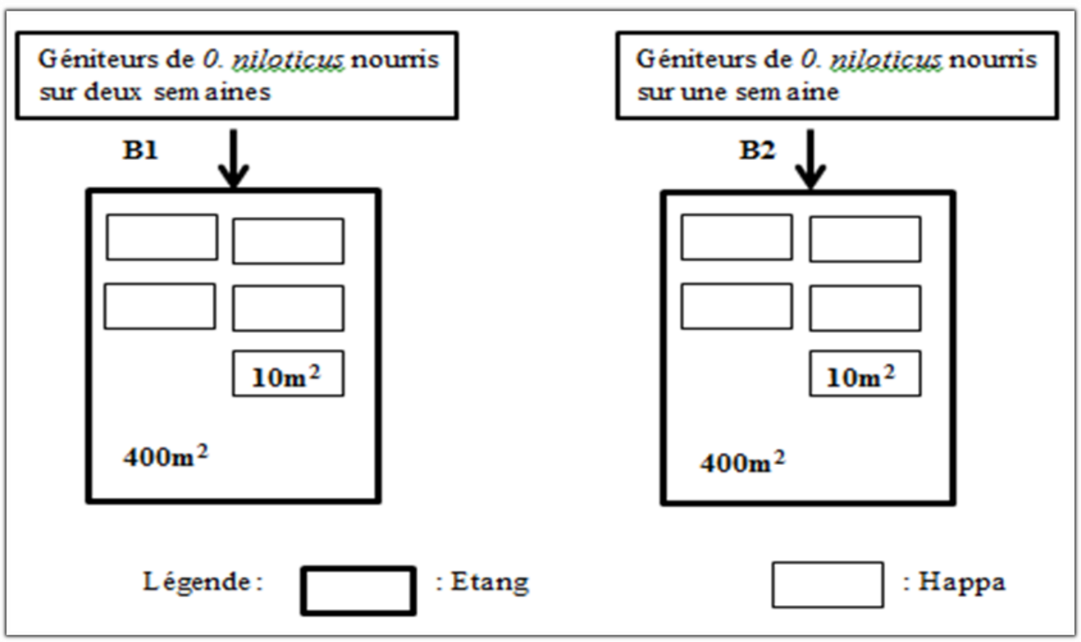

Figure 2: Reproduction ponds used at the CNRA fish station (Bouaké, Ivory Coast).

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2.2. Larval breeding: Two larval samples desired for each production technique used were collected (one batch of 30 larvae and another of 450 larvae). The collected larvae were measured with a Wild light microscope and weighed to assess the quality (size and weight) of the larvae. As for the 450 larvae collected for each production technique, they were transferred in groups of 150 in experimental aquaria of (100 cm x 50 cm x 40 cm) 200 liters of volume on the same day of harvest with triplicates **(Figure 3)** . The aquariums were supplied with drilling water by an electropop. The larvae were distributed at a density of 1 larva / l and fed with a powdered food containing 50% protein (composition: fish meal, wheat flour, fish oil, corn gluten meal, wheat flour). Poultry, soya flour and wheat gluten, methionine, choline chloride, vitamin and mineral mixture) with a particle size of less than 0.2 mm. The ration was prorated for biomass and divided into five meals (8h, 10h, 12h, 14h and 16h) for 56 days. This food ration used was 9% of the biomass. Every two days (6 am -7 am) food particles not ingested by the larvae as well as faeces were siphoned off using a hose before food distribution. A batch of thirty (30) individuals was randomly taken every two weeks by aquarium, weighed individually using a SARTORIUS electronic scale with a capacity of 220 g (accuracy 0.0001 g) to to compare the growth of the larvae from the two production techniques and readjust the food according to the total biomass.

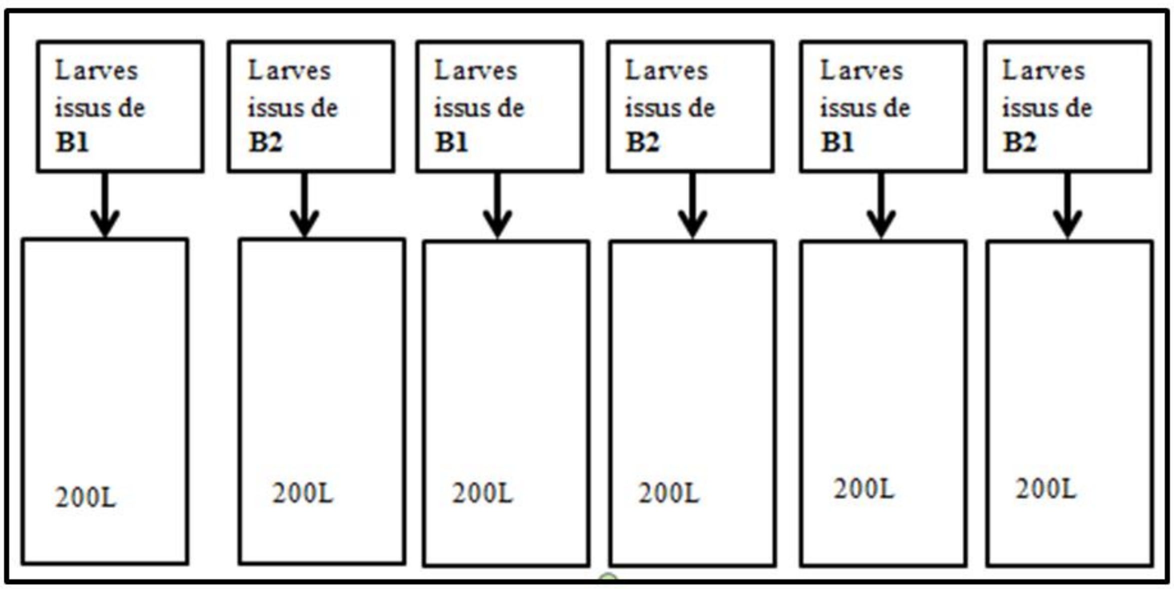

Figure 3: Aquariums 200 L each use for live stock Laval stages.

2.3. Measurement of physicochemical parameters: Abiotic parameters were measured in situ. A portable multi-parameter Model "HANNA Instruments HI 83141 pH & Water Analysis" was used to simultaneously measure temperature values in degrees Celsius and pH. Dissolved oxygen (mg / l) was measured using a portable oximeter Model "HANNA Instruments HI 9146". Regarding transparency, it was measured using a Secchi disk. Measurements were made once a week at 6 am and 2 pm

In the aquarium physico-chemical parameters such as temperature, dissolved oxygen, pH and water conductivity were monitored between (6 h-7 h) every two weeks. At the end of the aquarium experiment, all the larvae were recovered separately by production technique, counted, to determine the follow-up rate.

2.4. Determination of zootechnical performance parameters: The zootechnical parameters were calculated to evaluate the growth performance of the fish according to the formulas set out in **Table 1.**

Table 1: Formulas for calculating zootechnical performance and production parameters [9].

parameters	Formulas
Average weight gain: GPm (g)	Final weight - initial weight
daily growth: Cj (g/j)	(Final weight (g) - Initial weight (g)) / Feeding duration (j)
specific growth rate: TCS (%/j)	[(Ln Pf - Ln Pi) / Breeding time] × 100
Protein Efficiency Coefficient: CEP	Weight gain / Amount of protein ingested
nutrient Quotient: Qn	Amount of feed distributed / Fresh weight gain
Survival Rate: Ts (%)	(Final number of fish / initial number of fish) × 100

2.5. Statistical processing of data: The data collected were processed using the software R. The comparison of the means of the various parameters were made with the Student's T test. The objective of the analysis of variance is to know if there is a statistically significant difference ($p < 0.05$) or not between the studied parameters.

3. RESULTS

3.1 Productions of eggs and larvae: The production obtained during this test was very significant among broodstock (B2) fed on a week (1274 larvae + 13595 eggs) compared to that observed in broodstock (B1) fed over two weeks (6770 larvae + 52 eggs). The data obtained are presented in **Table 2.**

Table 2: Production of eggs and larvae (a> b, $p < 0.05$).

Productions	Ponds	
	B1	**B2**
larvae	6770^{a}	1274^{b}
egg	52^{b}	13595^{a}

3.2. Larger stage zootechnical parameters: The values of the various zootechnical parameters obtained after 56 days of rearing are presented in **Table 3.**

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Table 3: Zootechnical parameters of larvae *O. niloticus* in the aquarium during rearing (a> b; p <0,05).

Production settings	Aquarium	
	AQ1 (B1)	AQ2 (B2)
Initial weight (Pi)	0,027 ± 0,012[a]	0,015 ± 0,001[b]
Final weight (Pf)	2,05 ± 0,538[a]	1,39 ± 0,365[b]
Total weight gain (Gpt)	2,02 ± 0,539[a]	1,37 ± 0,365[b]
Daily weight gain (GPj g / J)	0,036 ± 0,009[a]	0,025 ± 0,007[b]
Specific growth rate (Tcs % j)	8,03 ± 0,423[a]	7,78 ± 0,812[b]
Nutrient Quotient (Qn)	1,22 ± 0,327[b]	1,76 ± 0,386[a]
Survival rate (Ts %)	53,33 ± 21,939[a]	40,67 ± 6,766[b]
Protein Efficiency Coefficient (CEP)	1,76 ± 0,469[a]	1,19 ± 0,317[b]

AQ1 = Set of aquariums whose larvae are from pond B1
AQ2 = Set of aquariums whose larvae are from pond B2

3.3. Weight growth: At the end of the 56 days of larval rearing, the evolution of the average weight of the different populations of tilapia (*O. niloticus*) was noted (**Figure 4).** The two curves obtained reflect the growth performance of the larvae from the two production techniques. The larvae from these two techniques show substantially similar growth after the first 14 days of rearing.

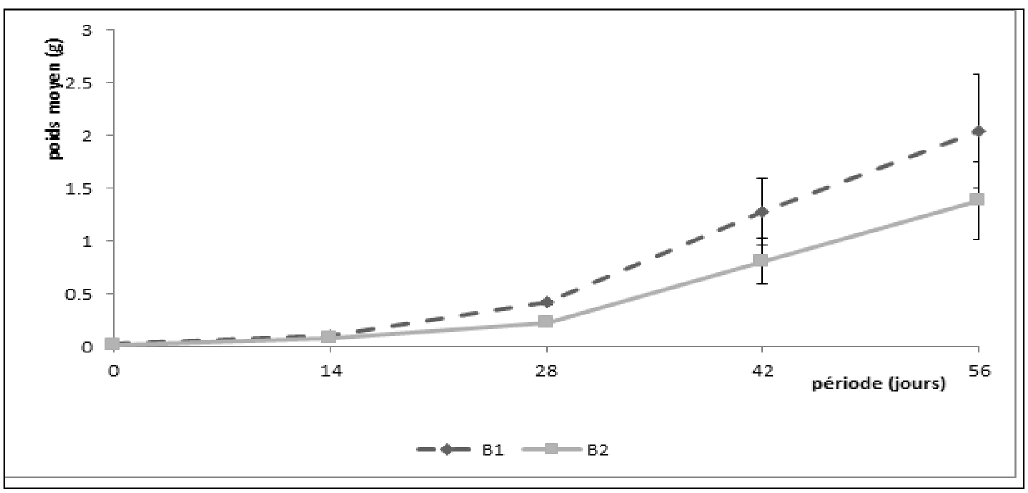

Figure 4: Growth curves of *O niloticus* raised in aquarium larvae. The averages are represented ± the deviations

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However, larval growth from broodstock (B1) is slightly higher (0.103 g) than that from broodstock (B2) (0.081). Beyond this period, fry (AQ1) from spawners (B1) fed over two weeks had a much higher growth performance. Indeed, the average weight remains higher than those of the larvae (AQ2) from the parents (B2) who were fed only for a week until the end of the experiment. After 56 days of culture, average weights increased from 0.027 ± 0.012 g (AQ1) to 2.05 ± 0.538 g (AQ1); 0.015 ± 0.001g (AQ2) at 1.39 ± 0.365g (AQ2). The weight gain (CP) recorded was significantly better ($p < 0.05$) in larvae (AQ1) than those (AQ2).

3.4. Daily weight gain: The daily averages of weight gain after 56 days of breeding are summarized in **Table 3.** These average values are 0.036 ± 0.009 g / day (AQ1); 0.025 ± 0.007 g / day (AQ2). The daily weight gain (GPj) recorded in the larvae (AQ1) in this study was higher than in those (AQ2). The daily weight gain observed between larvae (AQ1) and larvae (AQ2) showed a significant difference ($p < 0.05$).

3.5. Nutrient Quotient and Protein Efficiency Ratio Data on food use parameters (Qn, CEP) are presented in **Table 3.** Mean nutrient quotient (Qn) values for harvest use in these larvae were 1.22 ± 0.327 (AQ1); 1.76 ± 0.386 (AQ 2). The mean protein efficiency coefficients (PEC) were 1.76 ± 0.469 (AQ1); 1.19 ± 0.317 (AQ 2). Larvae (AQ1) had a lower nutritional value quotient and higher protein efficiency than larvae (AQ2). The values of the nutrient quotient (Qn) and the protein efficiency coefficient varied significantly ($p < 0.05$) during rearing for these two batches of larvae from different techniques.

3.6. Survival rate: Survival rates at 56 days of larval rearing were 53.33 ± 21.939 (AQ1) and 40.67 ± 6.766 (AQ2).

4. DISCUSSION

The different physicochemical parameters studied at the end of this breeding trial present values quite close to each other for the two breeding structures used (pond and aquarium). These values are within the recommended range for rearing fish according to the standards presented **by Cazin [10]**.

With regard to production, we found that broodstock (B2) fed on a week (1274 larvae + 13595 eggs) was higher than the production obtained in broodstock (B1) fed over two weeks (6770 larvae + 52 eggs). This could be explained by the fact that the dietary restriction of the parents (B2) caused a stress which would have caused a massive production of these. Indeed, when the fish is stressed and feels in danger it develops a survival instinct in order to perpetuate its species. The low larval production observed in broodstock (B2) could be explained by the delay in reproduction. In fact, the quantity of larvae obtained at harvest was small compared to the total production. For pond spawners (B1) this low observed productivity indicates that some breeding females did not participate in breeding during the study period. This originates in the effect of social dominance. Because within the same population, hierarchy is quickly established and dominant females reproduce more frequently than others[11]. In addition, Barcellos [12] indicates that males of Tilapias are aggressive in nature and dominant males control the majority of spawners and therefore many females do not reproduce. Each group has its own hierarchy[13]. Such hierarchies can affect the performance of fish in a variable way according to their social status.

The zootechnical performances of the fish from the parents (B1) are much higher than those from the parents (B2). Indeed, the specific growth rates (TCS) obtained are 8.03 ± 0.423% / d (AQ1) and 7.78 ± 0.812% / d (AQ2). Our results are interesting compared to data reported with more balanced diets (specific growth rate greater than 3% / j), [14]. As for nutrient quotients (Qn), the averages obtained [(1.22 ± 0.327 (AQ1) and 1 , 76 ± 0.386 (AQ2)] are comparable to values (1.76 - 2.26) reported by Gaber [15,16] (1.50 - 2.17). For [17] a good

IQ must be less than 3. The differences observed between the growths performances of the two batches of fish are due to the quality of the larvae. In fact, the analysis showed that the highest values of final average weight, Weight gain (Gp), daily growth, Protein efficiency coefficient (PEC), and Specific growth rates were obtained in fish from bloodstock. (B1) also characterized by the lowest nutrient quotient. This low nutrient quotient justifies the good quality of the food, which would be more easily digested and easily assimilated by fish (AQ1) than those (AQ2).

At the end of this test, the survival rates obtained were very low (53.33 ± 21.939% (AQ1) at 40.67 ± 6.766% (AQ2) compared to studies conducted on the same species by some authors such as 18 who observed 84 to 98% survival [9] recorded 75 to 94% survival, while Fiogbe[19] observed 86.67 to 97.78% survival, but the difference observed between the two survival rates is significant (p. <0.05) Mortalities observed do not seem to be related to the quality of the food with regard to the composition of the food and the amount of food distributed according to the biomass, but attacks between individuals have been observed. to the distribution of the food due to the heterogeneity of the sizes between the fish. For these authors, these aggressions are synonymous with the phenomenon of cannibalism intensified by a heterogeneity of the sizes between the fish [20,] the inter-individual contacts [21] and the competition[22].

This was also confirmed by Fontaine and Le Bail[23] and Hounsoun[24] who showed that lesions resulting from aggression between individuals, reflecting the phenomenon of cannibalism. The low survival rate observed is not only related to the phenomenon of cannibalism but also by the stress of handling. Indeed after the manipulations, the mortalities occurred one, two days, or three days later. On the other hand, in natural conditions, in the river for example, several authors have shown that the survival of the fry from the larger eggs[25] is better. Survival rates[26] in fish are dependent on the size and energy reserve of individuals.

The weight growth curves observed during larval rearing of the two batches of larvae have two main phases:

The first phase which lasted 14 days was marked by a weak growth corresponds to a transition phase, during which the larvae do not have all the digestive faculties which is put in place gradually during this phase. They feed largely on the contents of their yolk sac and little artificial food during the first few days after opening the esophagus. The second phase of growth (14th day until the end of larval rearing), corresponding to feeding exclusively with the artificial feed. However, during this phase, the digestive system is well established and the larvae were able to convert the artificial food ingested. At the end of larval rearing, growth was higher in broodstock (B1) than in broodstock (B2).

The difference in weight growth observed between the larvae from the parent groups, would be related to the biochemical composition, the nutrient content of the vitelline vesicles and the size of the larvae at hatch. Indeed, for [27; 28], larvae from larger oocytes generally show better performance: they are larger at hatch and have a better growth rate. In general, larger oocytes tend to have a higher energy value[29].

The low growth of broodstock (B2) larvae is thought to be due to the restriction of the feed, which would have resulted in adverse physiological consequences on reproduction. broodstock and the quality of offspring. For the lesser energy[30] received by the females during periods of fasting thus resulted in a decrease in the oocyte reserves incorporated during vitellogenesis. Indeed, the quality and quantity of broodstock feed are important factors that influence egg viability. Thus work carried out on many female fish showed that the fertilized eggs were smaller and of poorer quality and the production of reduced milt [31, 32, 33, 34].

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5. CONCLUSION

This study has highlighted the possibility of quantitative and qualitative production of O larvae. niloticus through the establishment of a production technique by the management of the parents according to a food aspect. Our study shows that spawners fed the two-week food (B1) showed better zootechnical performance than those fed the food over one week (B2). However, the production obtained in spawners (B1) fed over two weeks was low compared to that of spawners (B2) fed over a week. However, the high egg production observed in broodstock (B2) fed over a week does not guarantee a high production of larvae. On the other hand, the production technique used in broodstock (B1) offers the possibility of having quality larvae. The growth and survival rate of larvae from these spawners (B1) are also high. An overall analysis of the parameters studied shows that the technique used in broodstock (B1) would undoubtedly make it possible to make production profitable and reduce the production cycle of this species compared to that used in B2 breeders.

It would be important to carry out experiments on the entire breeding period from nursery to fish walking and also repeat this in other parts of the country and in other livestock structures where the renewal of water would be insured automatically. This renewal would limit fry stress by scouring performed every two days and improve their survival rate.

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