Testing the Reproductive Potential of Nile Tilapia (*Oreochromis niloticus*) under Eco Technological Conditions from Nucet

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Abstract. The experiment was carried out at the period range from 01.07 till 01.09.2010 at the Fish Culture Research and Development Center Nucet. The breeders were stocked in fiberglass tanks (Ewos tanks) of 1 m³ placed in a closed station. The breeders were stocked at three different densities, respectively: first variant (V_I)–8 fish/tank, second variant (V_II)–12 fish/tank and third variant (V_III)–16 fish/tank, in all three variants the male–female ratio was 1:3. All variants were accomplished with three replications. In all three variants, the average mass and length of brood fish were almost the same, respectively 80–110 g/fish and 13–15 cm. Feeding of breeders was carried out daily according to consumption rate using a special diet for tilapia represented by the Aller Aqua fodder (Aller Tilapia) of 3 mm diameter and 33% crude protein. The results are as follow, in variant V_I, 83% of females spawn and were achieved 55 larvae/female, in variant V_II, 77.7% of females spawn and were achieved 49 larvae/female, in variant V_III, 58% of females spawn and were achieved 38 larvae/female. Ratio male:female of 1:3 confirmed the results from literature offering good results on controlled spawning, but increasing the density of breeders lead to decreasing of spawning activity and increase of cannibal behavior of breeders with larvae. The results achieved on experiments of controlled spawning of Nile tilapia (*Oreochromis niloticus*, L.) accomplished at Fish Culture Research and Development Center Nucet evidence the plasticity of this species considering the new technological and environmental conditions.

Keywords: Nile Tilapia, controlled spawning, Ewos tanks

INTRODUCTION

Description of reproductive strategies and the assessment of fecundity are fundamental topics in the study of the biology and population dynamics of fish species and also for evaluation of the reproductive potential of individual fish species (Kariman and Hanan, 2008).

The Nile tilapia, *Oreochromis niloticus* (Pisces: Cichlidae), is an important fish in the ecology of tropical and sub-tropical region including Egypt. It is the most popular species of the bony fish in Africa (Abdel *et al.*, 2007; Offem *et al.*, 2007). This is attributed to many positive qualities including tolerance to poor water quality, wide range of food, plasticity in growth, firm flesh and good taste (Fryer and Iles, 1972; Ugwumba, 1988) and the ability to efficiently convert organic and domestic wastes into high quality protein (de Graaf and Huisman, 1999). All these valuable characteristics increase the interest for the species in many occidental countries, including from temperate and could areas where tilapia is reared in recirculating systems.

The purpose of the present study was to investigate the possibility of controlled spawning of Nile tilapia (*Oreochromis niloticus*, Linnaeus, 1757) under eco technological conditions from Nucet, as a trial to elaborate the culture technology for Romanian aquaculture.
MATERIALS AND METHODS

The experiment was carried out at the period range from 01.07 till 01.09.2010 at the Fish Culture Research and Development Center Nucet. The breeders were stocked in fiberglass tanks (Ewos tanks) of 1 m³ placed in a closed station (Fig. 1). The water feeding of station is accomplished gravitationally from a settling pond (BPrm³) and the feeding system of tanks is flow-through.

Fig. 1. Ewos tanks for controlled spawning of tilapia

The breeders were stocked at three different densities, respectively: first variant (V₁)–8 fish/tank, second variant (V₂)–12 fish/tank and third variant (V₃)–6 fish/tank, in all three variants the male–female ratio was 1:3. All variants were accomplished with three replications. In all three variants, the average mass and length of brood fish were almost the same, respectively 80–110 g/fish and 13–15 cm.

Male and female breeders may be easily differentiated by the shape and color of the body (Fig. 2).

Fig. 2. Morphological aspects of tilapia breeders

As can be seen during spawning, the coloring of male is more marked then for the female, the male is red colored on fins and head and present blobby-lips. At the female the main feature is the crowned abdomen and the color is faded.
Other external differences between sexes are based on the fact that males have two orifices under its belly, in which, one is the anus and the other the urogenital aperture. The female has three; the anus, the genital and the urinary apertures (Fig. 3–sketch after Beveridge and McAndrew, 2000 and original photo).

For the experiments of controlled spawning of Nile tilapia, achieved at Research Center Nucet, were selected the males that release sperm on soft abdominal pressure and the microscope observations confirmed the viability of spermatozoa (Fig. 4).

At females the criteria for selection are represented especially by the crowned and soft abdomen.

The reproduction mode of this species is quite interesting. The Nile tilapia female repeatedly release a string of about 20–50 eggs (Rothbard, 1979); then the male passes right over the eggs with his genital papilla pressing against the bottom of the tank and release a cloud of milky milt. The female returns immediately and takes the fertilized eggs into her mouth.

Studies have shown that Nile tilapia egg fertilization also occurs inside the female’s mouth (Mansour, 2001).
Incubation of eggs occurs inside of female’s mouth (Fig. 5), after hatch, larvae remain in female’s mouth until the yolk sac is finished and begin to feed.

![Image of a fish with eggs in the mouth](image)

**Fig. 5. Female with eggs in the mouth**

When larvae leave the female’s mouth, after finished the yolk sac, were absorbed through the evacuation system of tank and harvested in Nucet incubators disposed under the evacuation flow. From incubators larvae were moved after counting into a concrete tank of 120 m$^3$.

Feeding of breeders was carried out daily according to consumption rate using a special diet for tilapia represented by the Aller Aqua fodder (Aller Tilapia) of 3 mm diameter and 33 % crude protein.

During the experiment, water temperature was determined daily and chemical analyses were accomplished weekly.

For observation on electronic microscope 10×, sperm was colored with May Grumwald–Giemsa. All pictures from the present paper were captured with a photo camera model Canon A640–10 mega pixels connected to the electronic microscope for capture of tilapia sperm and eggs.

The graphics from paper were accomplished using the computer program Microsoft Excel 2003.

Chemical analyses of water were conducted in laboratory of Fish Culture Research and Development Center Nucet by analytical method.

**RESULTS AND DISCUSSION**

Water temperature ranged from 26 to 28.3°C in all three variants, the optimum temperature for best hatching and survival rates ranges from 25 to 32°C. The decrease in water temperature below 22°C in subtropical areas can lead to a delay or decrease in seed production, as has been reported at Nile tilapia in Vietnam (Green *et al.*, 1997) and Egypt (El-Naggar *et al.*, 2000).

The physical-chemical analyses of water indicated some differences between the three experimental variants (Tab. 1).

As can be seen for some chemical parameters the differences between experimental variants were high but the values did not exceed the normal range for spawning of Nile tilapia. Although the minimum values of dissolved oxygen decrease in all three variants below 4 mg/l, this wasn’t affect the spawning process.
### Tab. 1

The main chemical parameters of technological water

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<td>1</td>
<td>pH</td>
<td>U pH</td>
<td>4 -11</td>
<td>8.0 – 8.2</td>
<td>7.8 – 8.2</td>
<td>7.8 – 8.4</td>
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<tr>
<td>2</td>
<td>Alkalinity (ml HCl/l)</td>
<td></td>
<td>2.0 – 3.2</td>
<td>2.2 – 2.9</td>
<td>1.5 – 2.5</td>
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<tr>
<td>3</td>
<td>Total Hardness (°D)</td>
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<td>3.80 – 5.96</td>
<td>3.92 – 5.82</td>
<td>2.35 – 4.14</td>
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<td>4</td>
<td>Dissolved Oxygen (mg O₂/l)</td>
<td></td>
<td>3.5 – 14.1</td>
<td>3.8 – 6.2</td>
<td>3.1 – 5.7</td>
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<td>5</td>
<td>CO₂ Manganese (mg/l KMnO₄)</td>
<td></td>
<td>14.6 – 30.2</td>
<td>9.3 – 24.3</td>
<td>17.45 – 38.4</td>
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<td>6</td>
<td>Ammonia (NH₄⁺) (mg/l)</td>
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<td>&gt;15/&lt;3</td>
<td>1.29 – 2.91</td>
<td>1.43 – 2.67</td>
<td>1.09 – 2.99</td>
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<td>7</td>
<td>Nitrite (NO₂⁻) (µg/l)</td>
<td></td>
<td>&gt;5/&lt;1 mg/l</td>
<td>0.038 – 121.02</td>
<td>0.019 – 134.64</td>
<td>0.026 – 0.174</td>
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<td>8</td>
<td>Nitrate (NO₃⁻) (µg/l)</td>
<td></td>
<td>&gt;500/&lt;20 mg/l</td>
<td>0.06 – 193.1</td>
<td>0.02 – 128.31</td>
<td>0.02 – 0.263</td>
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<td>9</td>
<td>Phosphate (PO₄³⁻) (mg/l)</td>
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<td>traces</td>
<td>0.02</td>
<td>0.01 – 0.072</td>
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The development time that the fertilized eggs of tilapia takes to hatch ranges from <3 to >6 days (Abdel-Fattah, 2006) depending on many factors including water temperature, salinity, water flow and broodstok nutrition (Fig. 6).

![Fig. 6. Different stages of embryonic development on Nile tilapia](image)

At the end of experiment were determined the number of females that spawn and the number of larvae per female in each experimental variant (Fig. 7).
As can be seen the best results were achieved in the variant (V₁) with 8 breeders per tank. Decrease of number of females that spawn in inverse ratio to the increase of breeders’ number per tank can be explaining by the fact that males are very territorial and increasing their density can lead to intensification of fights and decrease of spawning activity (Broussard et al., 1983).

The smaller number of larvae per female achieved in the variants where the density of breeders was higher can be explaining by the intensification of cannibalism, especially because the females haven’t a synchronous spawn, those without eggs or larvae in the mouth will eat the larvae escaped from other female.

CONCLUSIONS

The results achieved on experiments of controlled spawning of Nile tilapia (Oreochromis niloticus, L.) accomplished at Fish Culture Research and Development Center Nucet evidence the plasticity of this species considering the newly technological and environmental conditions.

Controlled spawning without any hormonal stimulation or water temperature manipulation avail the assuredness that Nile tilapia can be cultured in Romanian aquaculture as long as during winter, water temperature from the culture system keep up to ≤18°C.

The male: female ratio can ranges from 1:5 in ponds to 1:10 in tanks and hapas, but a ratio of 1:3 appears optimum according to specially literature, therefore in our experiment we applied the ratio of 1:3 in all three experiments and as can be observed the results were satisfactory.

Increasing the density of breeders lead to decreasing of spawning activity, presumably do to aggression and fighting between males leading to reduction in courtship, egg fertilization and incubation. Also by increasing the density is increase also the cannibal behavior of breeders with larvae.

Harvesting larvae in Nucet incubators through the evacuation flow of Ewos tanks facilitated separation of larvae from breeder without disturbing the spawning process especially because females don’t spawn at the same time.

During experimental time, feeding of breeders was accomplished daily according to consumption intensity, independent of spawning activity. According to specialty literature (Watanabe, 1985; Finn, 1994) spawning performance and seed production of tilapia are directly related to broodstock nutrition. Despite the fact that eggs can absorb some nutrients directly from water, egg yolk remains the major source of nutrition for embryonic
development in fish. The exogenous nutrition of broodfish provides the essential nutrients required for the gonadal development of females and performance of the seed produced. Therefore, an inadequate food supply for fish broodstock will lead to poor productive performance and seed production.

REFERENCES


