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Performance of Monosex Fry Production of Two Nile Tilapia Strains: GIFT and NEW GIPU

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Abstract: A study was conducted to know the performance of GIFT and NEW GIFU tilapia to produce monosex tilapia for a period of 4 months from March to June, 2010 by using controlled on-station experimentation. The egg production, hatching rate and fry survival rate in both strains were assessed to know their performance. For monosex fry production, fertilized eggs were collected from the female mouth directly from breeding *hapas* placed in pond and were kept in jar incubation system in hatchery. Fries were obtained after an incubation period of 90-96 hours. The highest (118.33 eggs / female of GIFT tilapia and 334.61 eggs / female of NEW GIFU tilapia) egg production was found in March and the lowest (23 eggs / female of GIFT tilapia and 28.73 eggs / female of NEW GIFU tilapia) egg production was found in May. The monthly average egg production (138.34 ± 134.6725 no. / female), average hatching rate (54% ± 0.0465) and average fry survival rate (73.20 % ± 0.0564) were found in NEW GIFU tilapia which were higher than that of the GIFT tilapia strain (monthly average egg production 63.08 ± 40.92 no. / female, average hatching rate 50.34% ± 0.0295 and average fry survival rate 70.21 % ± 0.0476). The androgen hormone 17-"-Methyltestosterone (MT) was administered orally to the three day old fry at their first feeding stage at the dose of 60 mg / kg feed. After hormone treatment, the treated fries were transferred to *hapas* placed in pond for further rearing (21 days). The results demonstrate that the dose of MT-60 for 21 days was sufficient to produce 95 % male population of the GIFT strain and 99 % male population of the NEW GIFU strain. The finding of the present study suggests that the introduction of NEW GIFU tilapia strains in Bangladesh could lead to significant increase in fish production and hence the economic gains.

Key words: GIFT % NEW GIFU % Egg % Methyltestosterone (MT)

INTRODUCTION

Tilapias (Cichlidae) are natives of Africa. They have been introduced into a large number of tropical and subtropical countries around the world since the 1960s [1]. Tilapia was first introduced in Bangladesh in 1954. About 80 species of tilapia have been described out of which 10 species are reported to be used for culture [2]. Tilapias have distributed to so many different types of water, to so many different types of culture systems in the world that they have been even labeled as the "aquatic chicken" [3]. They have good resistance to poor water quality and disease, tolerance of a wide range of environmental conditions, ability to convert efficiently the organic and domestic waste into high quality protein, rapid growth rate and tasty flavour [4]. The existing strain Nile tilapia (*Oreochromis niloticus* L.) was first introduced into this country by the United Nations International Children Emergency Fund (UNICEF) in 1974 and later by the Bangladesh Fisheries Research Institute (BFRI) from Thailand [5].

Tilapia has been extensively genetically modified. One promising Genetically Improved Farmed Tilapia strain known as GIFT [6] has been introduced in July 1994 from the Philippines. The GIFT (5^{th} generation) strain was developed by the International Center for Living Aquatic Resources Management (ICLARM) through several generations of selection from a base population involving eight different strains of Nile tilapia, *Oreochromis niloticus* [6]. It performs 60% better growth and 50% better survival than the commercially available strains of tilapia [7]. GIFT and GIFT-derived strains are now being cultured widely across Asia, which today produces about 80% of all farmed.

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NEW GIFU tilapia is the 11th strain of *Oreochromis niloticus* was introduced in Bangladesh from China, developed by Professor Li Sifa, Shanghai Fisheries University, China. In China, experiments showed that NEW GIFU tilapia strain grew more than twice as fast as the local commercial strain. On average a 200 g breeder would produce 200-500 fry per month. Fry production will also depend on the condition and health of the breeders [8]. Nile tilapias (75 to 500 g) deposit from 50 to 2,000 eggs per spawn [2]. NEW GIFU tilapia strain has faster growth rates and higher survival rates, thus increasing fish yields dramatically. These attributes, along with its stable, low price, have made tilapia an extremely popular food source in Bangladesh, especially among poor consumers. Kohinoor *et al.* [16] studied the breeding biology and monosex male seed production of GIFT strain of Nile Tilapia (*Oreochromis niloticus*) in hatchery under different conditions in Bangladesh. But comparison of monosex fry production between GIFT tilapia strain and NEW GIFU tilapia strain has never been reported. So the present investigation was undertaken to find out the comparison of egg production, hatching rate, fry survival rate and percentage of monosex fry production between GIFT tilapia strain and recently introduced NEW GIFU tilapia strain in Bangladesh.

MATERIALS AND METHODS

The study was carried out for 4 months from March to June, 2010 in Zubin Agro-based Industries Ltd (ZAIL), Noakhali, Bangladesh. On site experimentation include brood ponds, aquaria, incubation and hatching tanks, larval rearing tanks and *hapas*.

Brood Stock Management

Pond Preparation: The ponds were prepared by dewatering followed by sun drying. Eradication of fish left from the previous culture cycle was done. After draining the pond, lime was spread at the rate of 1kg / decimal over the pond soil and then was filled with water. 30 kg of 16 nitrogen- 20 phosphorous- 0 potassium fertilizer was added to the pond per hectare.

Sources of Brood and Stocking: For tilapia brood, GIFT strain fry was collected from Bangladesh Fisheries Research Institute (BFRI) and NEW GIFU tilapia strain fry was collected from Chaina. Fry were kept in 1 m x 1 m x 2 m *hapas* of 1.5-mm mesh in ponds at the rate of 400 fry per *hapa*. The sex ratio 3:1 (female: male) was maintained in each *hapa*.

Table 1: Monthly water quality parameters in brood ponds

Variable	March	April	May	June
Temperature	28-32°C	25-32°C	36-37°C	27-32°C
pH	7-8	7-8	7-8	7-8
Salinity	2 ppt	3 ppt	4 ppt	2 ppt
Dissolved oxygen	4-6 ppm	3.5-4.5 ppm	3-4 ppm	3-5 ppm
Transparency	20 cm	25 cm	30 cm	22 cm

Water Quality: The following physico-chemical parameters of water of the ponds were maintained during the period (Table 1).

Feed and Feeding Schedule: A special feed enriched with protein and vitamin E, was formulated which enhances the gonad maturation in tilapias. Feed was applied by weight at the rate of 4 % total body weight of tilapia two times daily at 09:30 am and 04:00 pm respectively.

Regular Manuring: Regular manuring with cow dung was done at 15 days interval at the rate of 5kg / decimal and fertilization was done with urea and TSP at the rate of 100 g / decimal and 80 g / decimal respectively to stimulate the growth of plankton.

Six months aged matured GIFT and NEW GIFU tilapia strains were used as brood.

Procedure of Monosex Tilapia Fry Production

Egg Collection and Incubation: Adult females' mouths were checked for eggs every seven days. Eggs, or fry, were placed individually in buckets and transferred to aquaria at the hatchery of the Zubin Agro-based Industries Ltd. The fertilized eggs in the incubation jars started hatching after 72 hours of stocking. About 10000 eggs were placed in each incubation jar. Water flow through was installed in the jars from the bottom to the surface led to continuous movement of the eggs inside the jar. The hatchlings after absorption of their yolk-sac left the incubation jars with the water flow and were collected inside the hatching jar.

Rearing in Tanks: 8 x 4 x 2.5 cubic feet tank was employed for rearing of hatchling. 40000 fry were placed in each tank or sex reversal tank. Hatchlings were fed with 17 alpha-methyltestosterone mixed with powdered feed immediately after absorption of their yolk sac. Hormone was mixed at the rate of 60 mg / kg. Larvae were fed six times daily to apparent satiation at the rate of 100 % by body weight. The hatchlings were reared in tank for 3 days before transfer to the *hapas* set in a pond. The additional oxygen to tank was provided through aeration for 22 hours every from water circulation obtained by motor.

Fry Rearing in Hapa: All the hormone treated fry from the rearing tank were transferred into the hapa (16 x 8 x 3.5 cubic feet in size). The mesh size of the hapa net was 1 mm. Fries were fed at satiation level and continued feeding for about 3 weeks with hormone mixed feed. Fry fed (first 5 days) at the rate of 30 %, second 5 days at the rate of 20 %, third 5 days 18 % and fourth 5 days at the rate of 12 %.

Hatching rate and survival rate of fry was calculated by following equations:

Hatching Rate: Amount of hatched fry / Amount of fertilized eggs x 100.

Survival Rate: Amount of lived fry up to 21 days / Amount of hatched fry x 100.

RESULTS AND DISCUSSION

Egg Production: Total egg production was evaluated from 300 females GIFT tilapia and 300 females NEW GIFU is shown in Figure 1. It was seen that the highest egg (118.33 eggs / female of GIFT tilapia and 334.61 eggs / female of NEW GIFU tilapia) production was observed in March and lowest egg (23 eggs / female of GIFT tilapia and 28.73 eggs / female of NEW GIFU tilapia) production was observed in May among the GIFT and NEW GIFU tilapia strains.

Highest eggs production was seen in NEW GIFU tilapia than GIFT tilapia. According to present study, variation of individual eggs production was observed in GIFT and NEW GIFU tilapia. It was observed that total highest egg production per female was observed in March and lowest egg production/female was observed in May among the GIFT and NEW GIFU tilapia strains. Highest eggs production/female was seen in NEW GIFU tilapia than GIFT tilapia.

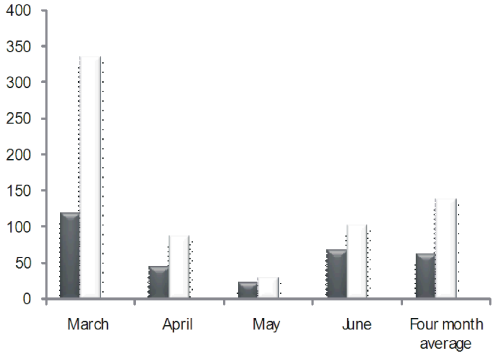

Fig. 1: Monthly produced no. of eggs / female by GIFT (indicated by black colour) and NEW GIFU tilapia (indicated by white colour)

The fecundity fluctuates widely from a few hundred to several thousand eggs, depending on the size and age of the female. It is reported that as the weight of GIFT strain *Oreochromis niloticus* increases to a range of 180-498 g, the number of eggs decreases. It means that absolute fecundity in this species is inversely correlated with the weight of sexually mature females [9]. Arredondo-Figueroa and Guzman-Arroyo [11] mentioned that *Oreochromis niloticus* is a mouth brooder with small gonads of less than 700 eggs. In this study, it was reported fecundity was higher than that observed by other workers for *Oreochromis niloticu*s. Because GIFT and NEW GIFU tilapia strain have genetic upgradation. Alex Bocek [13] observed 100-200 eggs produced per spawn by female tilapia at 28°C. In the present study the highest egg production was obtained in March at 28-30°C and lowest in May at 36-37°C. These effects were due to the roughest pond condition that is in May, there was extremely high water temperature (36-37°C). On the other hand, total egg production, individual egg production, hatching rate and survival rate were higher in NEW GIFU tilapia strain than GIFT. This effect was due to the genetically up gradation of NEW GIFU tilapia strain (11^{th} strain).

Hatching Rate: The hatching rate was evaluated from 300 females GIFT tilapia and 300 females NEW GIFU is shown in Figure 2.

It was seen that, highest hatching rate (53.32 % for GIFT tilapia and 58.33 % for NEW GIFU tilapia) was observed in March and lowest hatching rate (46.30 % for GIFT tilapia and 47.44 % for NEW GIFU tilapia) was observed in May among the GIFT and NEW GIFU tilapia strains. Highest hatching rate was seen in NEW GIFU tilapia than GIFT tilapia.

Survival Rate of Tilapia Fry: The survival rate was evaluated from 300 females GIFT tilapia and 300 females NEW GIFU is shown in Figure 3. It was seen that, highest survival rate was observed in March and lowest survival rate was observed in May among the GIFT and NEW GIFU tilapia strains. Highest survival rate was seen in NEW GIFU tilapia than GIFT tilapia.

Survival of *Oreochromis niloticus* ranged from 91.5 to 97.0 % during grow-out phase. Data showed no significant relationship between survival and MT treatment concentration or duration. Soto [18] and Vera-Cruiz and Mair [19] also concluded a similar result by observing that MT administration has no significant effect on survival in *Oreochromis niloticus*.

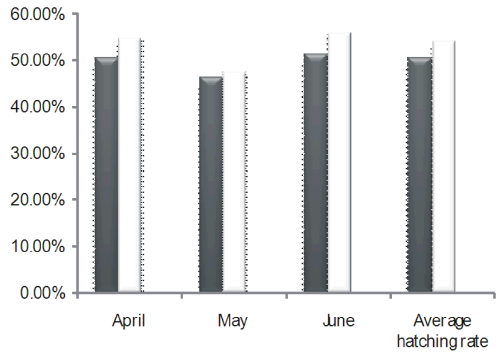

Fig. 2: Monthly hatching rate of GIFT (indicated by black colour) and NEW GIFU tilapia (indicated by white colour)

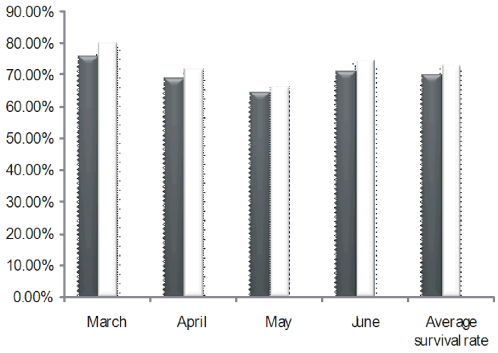

Fig. 3: Monthly survival rate of GIFT (indicated by black colour) and NEW GIFU tilapia fry (indicated by white colour)

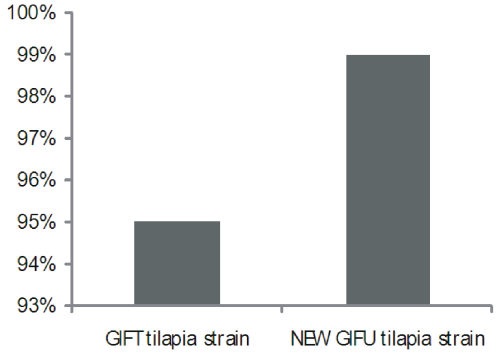

Fig. 4: Percent of monosex obtained by Zubin Agro-based Industries Ltd., from GIFT tilapia and NEW GIFU tilapia strain

The findings of Pechsiri and Yakupitiyage [17] were also similar to these with regard to survival rate (73.3-76.0 %) of *Oreochromis niloticus*. Average survival rate of fry (highest 76.08 % in GIFT, 79.96 % in NEW GIFU and lowest in 64.63 % GIFT and 66.42 % in NEW GIFU). The lowest rate of fry survival rate in May was caused by extremely high temperature.

Percent of Monosex Tilapia: According to the present study, variation of monosex production (%) was observed in GIFT and NEW GIFU tilapia. 99 % monosex tilapia was found in NEW GIFU tilapia and 95 % monosex tilapia was found in GIFT tilapia.

The effectiveness of sex reversal treatment depends on the species, age when hormone is administered, type and dosage of hormone, time and duration of treatment [10]. Jalbert *et al.* [15] reported that 100 % of male was achieved with a hormone dose at 40mg methyltestosterone / kg feed. Kohinoor *et al.* [16] studied 17 alpha methyltestosterone was applied orally to the fry at their first feeding stage with treatments- 1,2,3 and 4 at the dosage of 100, 80, 60 and 40 mg / kg feed respectively, for the period of 28 days. The mean percentage of males obtained in treatments- 1, 2, 3 and 4 were 98, 97, 95 and 68, respectively. Zubin Agro-based Industries Ltd., used 60mg methyltestosterone/kg feed and achieved 95 % males from GIFT broods and 99 % males from NEW GIFU was obtained by administration of same hormone dose and same percentage of protein. This dissimilarity may be due to species age at which hormone is administered, time, duration of treatment, low feed and hormone quality and environmental factors.

Percent of monosex tilapia of the study was shown in Figure 4.

The history of the GIFT strain has been described by Eknath and Acosta [14] and by Bentsen *et al.* [12]. At the time the fish were received in Malaysia the GIFT strain had undergone six generations of selection. But NEW GIFU had undergone eleventh generations of selection. That's why; NEW GIFU tilapia strain had higher egg production, higher hatching rate and higher fry survival rate than that of GIFT tilapia strain. In present study, it was seen that egg production was higher in NEW GIFU tilapia than GIFT tilapia strain. It is established that egg production depends on body weight. NEW GIFU tilapia strain is larger in size than GIFT tilapia strain. So, egg production was higher in NEW GIFU tilapia than GIFT tilapia strain.

CONCLUSION

The study was conducted to know the performance of monosex tilapia for a period of 4 months from March to June 2010. The study was carried out in Zubin Agro-based Industries Ltd. hatchery to know the monosex tilapia fry production system. The highest egg production, hatching rate and fry survival rate of GIFT and NEW GIFU tilapia strains were found in March and

the lowest egg production, hatching rate and fry survival rate of GIFT and NEW tilapia strains were found in May. The highest egg production, hatching rate and survival rate was found in NEW GIFU tilapia strain than the GIFT tilapia strain. The hatchery used 60mg methyltestosterone / kg feed and they get 95 % monosex tilapia from GIFT strain and 99 % monosex tilapia from NEW GIFI strain. But variable result found in different farms.

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