STUDIES ON THE STOCKING DENSITY OF HORMONE TREATED TILAPIA *(OREOCHROMIS NILOTICUS)* FRY

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ABSTRACT

With changing demand in Bangladesh, the tilapia (Oreochromis niloticus) has recently gained popularity among farmers. Since mortality play a vital factor in culture system and profitability, the present study was conducted to estimate the mortality in relation to stocking density of hormone treated tilapia (Oreochromis niloticus) in hapa culture systems. Pond preparation was done before the experiment was conducted with three treatments i.e. three different stocking densities namely $T_{1,}$ T_2 and T_3. Initial average weight of fish was 0.09g. A commercial powdered feeds fed at the rate of 35% body weight up to first seven days and then gradually it was readjusted to 25, 15 and 10%, respectively up to 28 days. The water quality parameter such as temperature, dissolved oxygen, pH, were monitored at seven days interval. At the end of the trial, the growth performances were evaluated by comparing mean final body weight, specific growth rate (SGR) and mortality rate. The mean total weight gain of T_3 (1170 ± 2.00g) was significantly higher than T_1 (1148.00 ± 2.00g), followed by T_2 (1345.00 ± 5.00g). Significantly ($P<0.01$) the higher SGR value (11.56) was recorded in treatment T_2 whereas the lower SGR value (10.52) was obtained in T_3. The values of mortality were recorded as 3.38, 12.50 and 20.96% in T_1, T_2 and T_3, respectively. The highest mortality (20.96%) was found in treatment T_3 whereas the lowest mortality (3.38%) was found in T_1. The production was found 5.252 kg/hapa/28days, 4.899 kg/hapa/28days and 4.881 kg/hapa/28days from $T_{1,}$ T_2 and T_3, respectively.

Keywords: Mean weight gain, Specific growth rate (SGR), Mortality, Survivability

INTRODUCTION

There are about 70 species of tilapia found where most of them are native to western rivers of Africa (Anon, 1984). Of these, nine species are generally found worldwide (FAO, 2002). However, tilapia production is concentrated mainly on Nile tilapia *(Oreochromis niloticus*), Mozambique tilapia *(O. mossambicus)* and Blue tilapia *(O. aureus)*. Of these three species, *Oreochromis niloticus* is currently considered to be the most important and commonly cultured tilapia species around the world, and constitutes over 70% of the cultured tilapia (Fitzsimmons, 2004). Tilapias are often cultured in freshwater ponds without supplemental feeding. Intensification of culture practices requires the use of external feed input (Essa and Salama, 1994). Tilapia production in developing countries occurs primarily in semi-intensive ponds with fertilization and/or supplementary feeding (Tacon, 1990). Supplemental feeds are

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applied to increase fish yields above those produced with fertilization alone (Knud-Hansen and Batterson, 1994). In fish farming practices, stocking density is considered to be one of the important factors that affect fish growth, feed utilization and fish yield (Liu and Chang, 1992). Furthermore, Ellis et al. (2002) reported that stocking density is a key factor in determining the productivity and profitability of commercial fish farms.

The use of mono-sex male tilapia fish is intrinsically desirable in a variety of fish species in a range of aquaculture production systems. It is widely cultured in many tropical and sub-tropical countries of the world (Lin et al., 2008). Tilapia fry has also the ability to survive under extremely low dissolve oxygen and increase water layer by reducing activity (Chervinski, 1982).

The Nile tilapia sexually became mature at the age of the month when it attain a body weight of around 40-60g (Hussain, 1989). In Bangladesh, it starts to breed from February and it is maternal mouth brooder, so the female immediately takes the eggs into her mouth for incubation. The male ejects milt over the eggs to effect fertilization immediately after deposition and fertilization activities occur over a period of up to 2-3 hours. Temperature is very essential for the egg production and growth of fry in hatchery system. The effects of water temperature on growth and development of fish have been well documented for many species (El-Sayed et al., 2004; Chatterjee et al., 2004; Larsson and Berglund, 2005). Optimal environmental conditions are needed to reach the best growth performance. But due to excessive temperature the production and growth of fry hampered and the hatchery operator cannot reach in its optimal production. Thus at higher or lower temperatures, feeding and growth are became almost stopped (Caulton, 1982). Brummett (1995) found that Nile tilapia did not lay eggs when water temperature went down below 19°C. The most productive period coincided with the rise in water temperature within 22 to 27°C where spawning rate averaged between 40 and 73% of total female under dark and natural photoperiod conditions, respectively.

Water temperature also governs the phenotypic sex of *Oreochromis niloticus*. Temperature supposed to cause a significant deviation of sex ratio in favour of male *Oreochromis noloticus* (Baroiller et al., 1996; Baras et al., 2001). Considering the enormous importance of the subject the present study was undertaken to estimate the mortality in relation to stocking density of hormone treated tilapia fry.

MATERIALS AND METHODS

Study site

The experiment was conducted in a private fish farm named "Authentic Matshya Hatchery". Situated at Sikarikanda under sadar upazilla of Mymensingh district. The total area of the farm was 3 acre, about 4 km away from Bangladesh Agricultural University (BAU), Mymensingh.

Experimental protocol

The experiment was carried out for a period of 28 days from 7 July to 4 August, 2012 to evaluate the effects of eggs and spawn quality and mortality after hormone treatment of tilapia (*Oreochromis niloticus)* in pond rearing system. To fulfill this objective, 0.009g spawn were stocked in the hapa set in the selected pond. The ponds were selected randomly to accommodate the relevant treatments. Nine hapa was set for three replication. The experimental layout is shown in Table 1.

Table 1. Experimental layout of monosex tilapia

Treatments	*Hormone dose (mg/kg)*	*Hapa size*	*Total stocking*	*Stocking quantity (g)*
T_1	60	$9m^3$(4.5×2×1)	4000	0.009
T_2	60	$9m^3$(4.5×2×1)	4500	0.009
T_3	60	$9m^3$(4.5×2×1)	5000	0.009

Collection and incubation of fertilized eggs

For gathering the different age groups of fertilized eggs or near to hatch larvae or yolk sac fry that were collected from mouth of the females are separated by their colours and were kept in separate plastic buckets placed in a bamboo frame. After that the eggs/larvae/yolk sac fry were shifted to the hatchery for incubation. Collected fertilized eggs/ hatched fry were incubated in a series of round bottom plastic jars and flat trays. Fertilized eggs/hatched larvae were stocked for incubation in each jar/tray by keeping about estimated number of 25000 eggs in each jar.

Pond preparation and hapa setting

The broken parts of ponds bank and embankment were repaired properly. Aquatic vegetation were cleared by repeated cutting. Undesirable species were removed by using seine and cast net. Rotenone was used (22gm/decimal) in pond to make sure about the complete removal of unwanted fishes and other species. The ponds were limed at a dose of 1 kg/decimal (274 kg/ha). After 7 days of liming the ponds were filled in with water. Fertilization was done in the pond with urea (60g/decimal) and TSP (90g/dec) to stimulate the productivity of ponds. TSP was applied into the ponds, after dissolving in plastic bucket 10-12 hours before application in the ponds. After preparation of the pond hapas were fixed into the pond. Hapas were set by using net. Each of the hapa was in volume $9m^3$ (4.5m×2m×1m).

Collection and stocking of spawn

The spawn were collected from "Authentic Matshay Hatchery" in Shikarikanda, Mymensingh Sadar, Mymensingh. In this experiment 7 days old fry were stocked in the experimental hapa.

Collection of feed and preparation of hormone mixed feed

Mega feed (powder) was collected from feed dealer Churkhai bazar. Sex reversal was done by feeding hormone mixed feed to fry. About 70 mg of 17 α-methyl testosterone (17α-MT) was dissolved in 100ml ethanol (99%). MT solution was mixed with feed at the rate of 60 mg hormone/kg feed. The feed was screened by fine meshed net. MT solution mixed with 1 kg powdered feed containing 36-40% protein for 10-15 minutes until all the feed was moist. The moist feed was air dried in direct sunlight, or stored in a mixer until dried. Androgens break down when exposed to sunlight or high temperatures. To prepare 5 kg feed for each treatment (i.e 60 mg MT hormone) was diluted with 500 ml ethanol for homogenous mixing with the feed. Hormones mixed dry feeds were stored at room temperatures. Hormone mixed dry feeds were stored at room temperature under dark and dry conditions.

Stocking, feeding and rearing of spawns

Stocking density of fry was 4000, 4500, 5000 in the following hapa T_1, T_2, and T_3, respectively. At the beginning of the experiment feed was supplied at the rate of 35% of the body weight of reared tilapia spawn and gradually it was readjusted to 25%, 15%, and 10%, respectively. The monosex tilapia were fed four times daily up to 28 days.

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Sampling of fishes

Fish were sampled at weekly interval to determine their weekly mortality and weight gain of fry. Sampling was done early in the morning when the fish stomach was about to be empty to avoid the presence of excessive feed. The weight was taken by analytical balance. To determine weekly mortality total weight was taken in individual hapas then counting was done. After recording weight and mortality, fry were released as respective hapas.

Measurement of water quality parameters

On each sampling day water temperature, dissolved oxygen (DO) and pH of water and sediment were measured using previously calibrated handheld devices. Transparency was recorded by a Secchi disc.

Growth performance and production of fish

The following formulae were applied to calculate the growth performance, mortality/ survivality and production of fish.

a) Weight gain= Mean final weight (g) – mean initial weight (g)

b) % weight gain= $$\frac{\text{Mean final weight gain} - \text{Mean initial weight gain}}{\text{Mean initial weight gain}} \times 100$$

c) Average daily weight gain (g)= $$\frac{\text{Mean final weight} - \text{Mean initial weight}}{T_2 - T_1} \times 100$$

Where, $T_2 - T_1$ = Duration of the experimental period

d) Specific growth rate (SGR) % per day = $$\frac{\log w_2 - \log_e w_1}{T_2 - T_1} \times 100$$

Where, W_1= Initial live body weight (g) of mono-sex tilapia.

W_2= Final live body weight (g) of mono-sex tilapia.

$T_2 - T_1$ = Duration of the experimental period

e) Final mortality = No of fry released- No of fry harvested

f) Mortality (%) = $$\frac{\text{No. of fishes died}}{\text{No. of fishes stocked}} \times 100$$

g) Survival rate (%) = $$\frac{\text{Number of fish harvested}}{\text{Number of fish stocked}} \times 100$$

h) Production = No. of fish harvested × Average weight of fish

Statistical analysis

The data obtained during the experiment were statistically analyzed to observe whether the influence of different stocking densities on the growth, mortality and production of fish were significant or not. One way analysis of variance (ANOVA) was performed to test the significance of variation among the treatments. Significant differences among different treatment means were identified by SPSS (Statistical Package for Social Science).

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RESULTS

Water quality parameters

Water temperature were found to range from 30 to 34.30°C during study period. The maximum water temperature was 34.30°C in treatments T_3 while the minimum was found 30°C treatment T_1. The mean values of water temperature were recorded as 31.86±1.53, 31.94±1.40 and 32.12±1.51°C in treatments T_1, T_2 and T_3, respectively (Table 2) and variation of temperature among the treatments were shown in Figure 1.

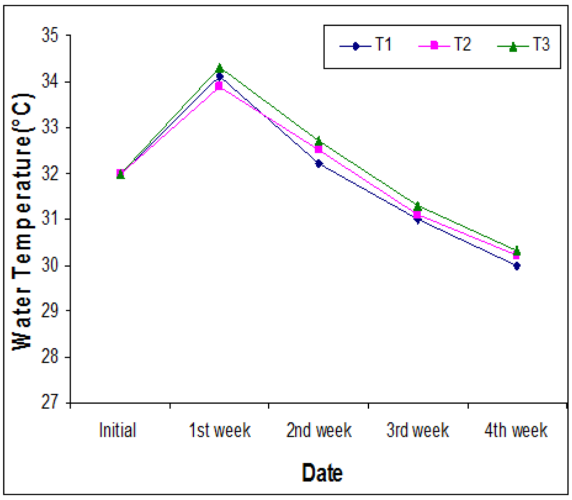

Figure 1. Weekly variation of water temperature (°C) in different treatments over 28 days

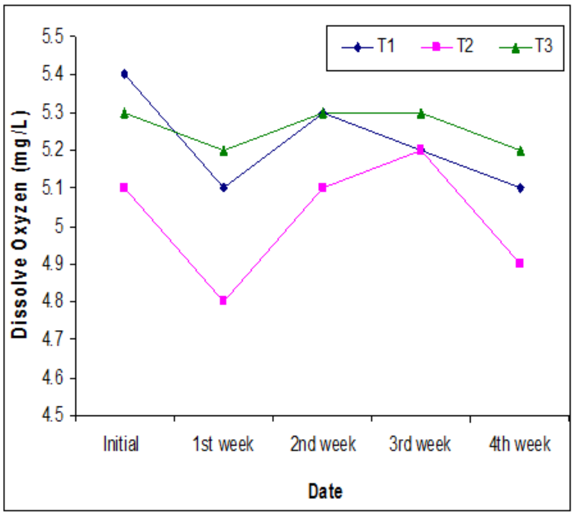

Figure 2. Weekly variation of dissolve oxygen (mg/l) in different treatments over 28 day

Dissolved oxygen (DO) content of the pond water was found to range from 4.8 to 5.4 mg/l during the study period. The maximum dissolved oxygen content was 5.4 mg/l in treatment T_1 while the minimum content was 4.8 mg/l in treatment T_2. The mean values of dissolved oxygen content were recorded as 5.22±0.13, 5.02±0.16 and 5.26±0.05 in treatment T_1, T_2 and T_3 respectively (Table 2) and variation of dissolved oxygen (DO) among the treatment are shown in Figure 2.

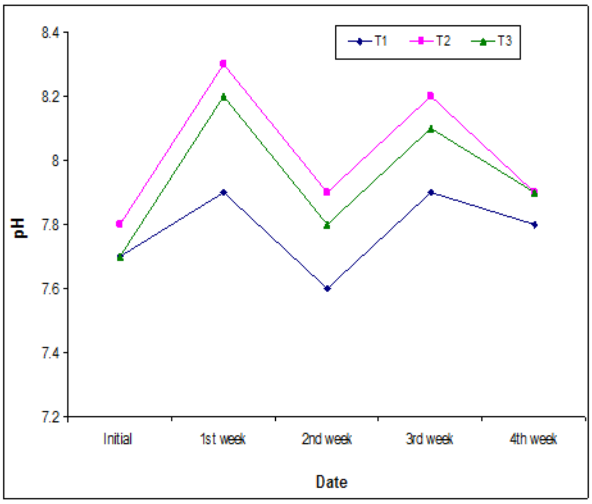

Figure 3. Weekly Variation of pH of water in different treatment over 28 days

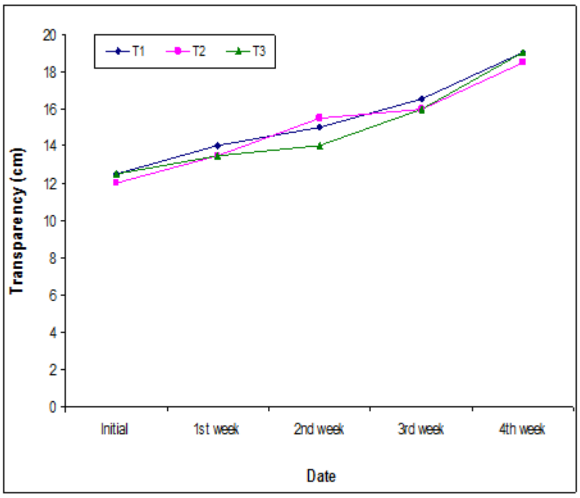

Figure 4. Weekly variation of transparency (cm) in different treatments over 28 days

The pH values were found to range from 7.6 to 8.3 during the study period. The highest value of pH was recorded from treatment T_2 while the lowest value of pH 7.6 was recorded from treatment T_1. The mean values of pH were observed as 7.78±0.13, 8.02±0.22 and 7.94±0.21 in treatments T_1, T_2 and T_3, respectively (Table 2) and variation of hydrogen ion concentration (pH) among the treatments are shown in Figure 3.

The values of water transparency were found to range from 12.0 to 19.0 cm during the study period. The maximum value of transparency 19.0 cm was recorded from treatment T_1 and T_3 while the minimum value of transparency 12.0 cm was recorded from treatment T_2. The mean values of transparency were recorded as 15.40±2.48, 15.10±2.48 and 15.00±2.57 in treatments T_1, T_2 and T_3, respectively (Table 2) and variation of transparency among the treatments shown in above Figure 4.

Table 2. Average (Mean ± SD) values of water quality parameter under different treatments throughout the study period

Treatments	*Temperature (°C)*	*DO (mg/l)*	*pH*	*Transparency (cm)*
T_1	31.86±1.53	5.22±0.13	7.78±0.13	15.40±2.48
T_2	31.94±1.40	5.02±0.16	8.02±0.22	15.10±2.48
T_3	32.12±1.51	5.26±0.05	7.94±0.21	15.00±2.57

Growth Performance of Tilapia Fry

The growth of tilapia fry in the three treatments in different stocking density was provided with three different hormone dose with starter feed. The result of growth performance have been presented in table 3.

Mean final weight

There were significant differences ($p<0.01$) among the different treatments. The highest total mean final weight gain was found in treatment T_2, whereas as the lowest total mean final weight was found in treatment T_1. The mean values of total final weight were observed as 1208.00±2.00g 1400.00±5.00g, 1235.00±2.00g, in treatments T_1, T_2 and T_3, respectively (Table 3).

Mean weight gain

There were significant differences ($p<0.01$) among the different treatments. The highest mean weight gain was found in treatment T_2, whereas the lowest mean weight gain was found in treatment T_1. The mean values of individual weight gain were observed as 1148.00±2.00g, 1345.00±5.00g and 1170.00±2.00g in treatment T_1, T_2 and T_3 respectively (Table 3) and variation of weight gain among the treatments were shown in Figure 5.

Percent mean weight gain

There were significant differences ($p<0.01$) among the different treatments. The highest mean value (2445.45±9.09) of percent weight gain was found in treatment T_2 whereas the lowest mean value (1800.00±3.08) of percent weight gain was found in treatment T_3 (Table 3).

Specific growth rate (SGR) percent per day

The mean specific growth rate of mono-sex male tilapia spawn in different treatments ranged between 10.52 and 11.56. The significantly ($p<0 .01$) highest SGR values 11.56 was recorded in treatment T_2 whereas the lowest SGR values 10.52 was obtained in treatment T_3 (Table 3) and variation of specific growth rate (%/day) among the treatments were shown in Figure 6.

Mortality of tilapia fry

Mortality and percent mortality

After rearing 28 days the highest mean mortality (1048±15.00) was found in treatment T_3, whereas as the lowest mean mortality (152.00±2.00) was found in treatment T_1. The mean values of individual mortality were observed as (152.00±2.00), (500.00±15.00) and (1048.00±10.00) in treatments T_1, T_2 and T_3, respectively (Table 4) and variation of final mean mortality among the treatments were shown in Figure 7. The values of mortality were recorded as 3.38%, 12.50% and 20.96% in treatments T_1, T_2 and T_3, respectively. The highest mortality 20.96% was found in treatment T_3 whereas the lowest mortality 3.38% was found in T_1 (Table 4) and variation of mortality (%) among the treatments were shown in Figure 8.

Survival rate (%)

The values of survivability were recorded as 96.62%, 87.50% and 79.04% in treatments T_1, T_2 and T_3, respectively. The highest survivability 96.62% was found in treatment T_1 whereas the lowest survivability 79.04% was found in T_3 (Table 3) and and variation of survivability (%) among the treatments were shown in Figure 9.

Production (kg/hapa/28 days)

The highest production was found 5.252 kg/hapa/28days from the treatment T_1 whereas the lowest production was found 4.881 kg/hapa/28days from treatment T_2. The mean values of production were observed as 5.252±0.011, 4.899±0.004and 4.881±0.020 in treatment T_1, T_2 and T_3, respectively (Table 3).

Table 3. Statistical analysis of growth parameter of monosex male tilapia (Oreochromis niloticus) observed in different treatment throughout the study period (28 days)

Growth parameters	*T_1*	*T_2*	*T_3*	*LSD*	*Level of sig.*
Mean initial weight (g)	55.00±0.00	60.00±0.00	65.00±0.00	0.00	ND
Mean final weight (g)	1208.00c±2.00	1400.00a±5.00	1235.00b±2.00	3.83	**
Weight gain (g)	1148.00c±2.00	1345.00a±5.00	1170.00b±2.00	3.83	**
% Weight gain	1913.33b±3.33	2445.45a±9.09	1800.00c±3.08	6.77	**
SGR (%/day)	10.72b±0.01	11.56a±0.01	10.52b±0.01	0.01	**
SGR (%)	300.24b±0.17	323.69a±0.36	294.44c±0.16	0.28	**
Survival rate (%)	96.62a±12.65	87.5b±10.46	79.04c±9.25	12.79	**
Average gain (g)	41.00b±0.07	48.04a±0.18	41.79b±0.07	0.14	**
Production (kg/hapa/28 days	5.252a±0.01	4.899b ±0.01	4.881c±0.02	0.02	**

** = Significant at 1% level of probability, ND = Not Done

In a column figures with same letter or without letter do not differ significantly whereas figures with dissimilar letter differ significantly (as per DMRT)

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Table 4. Average mean values of mortality and percent of mortality of tilapia (*O. niloticus*) fry in three treatments during study period

Treatments	*Stocking density fry (No/hapa)*	*No. of fry harvested*	*Mortality (No. of fry)*	*% Mortality*
T_1	4000.00±0.00	3848.00a±2.00	152.00c±2.00	3.38c±0.04
T_2	4500.00±0.00	4000.00c±15.00	500.00b±15.00	12.50b±0.38
T_3	5000.00±0.00	3952.00b±10.00	1048.00a±10.00	20.96a±0.20
LSD	0.00	12.08	12.08	0.28
Level of sig.	ND	**	**	**

** = Significant at 1% level of probability, ND= Not Done

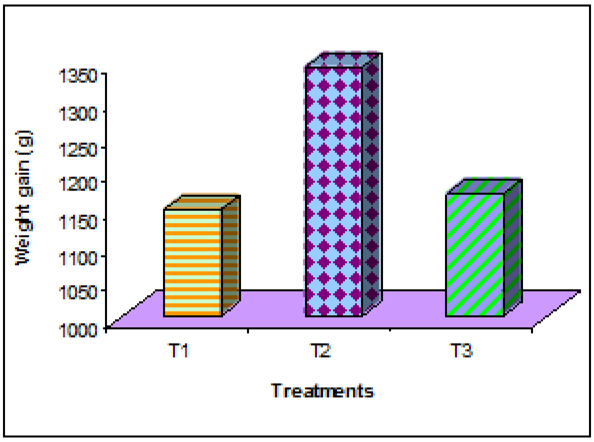

Figure 5. Comparison of the weight gain (g) of tilapia fry under three different treatment during study period.

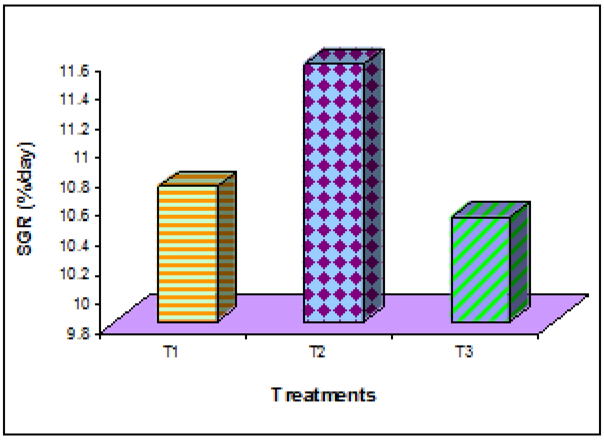

Figure 6. Comparison of the specific growth rate of tilapia fry in different treatments during the study period.

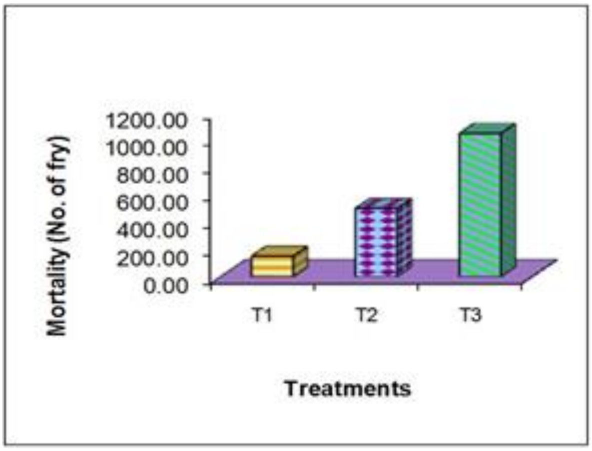

Figure 7. Comparison of the final mortality of tilapia fry in different treatments during the study period.

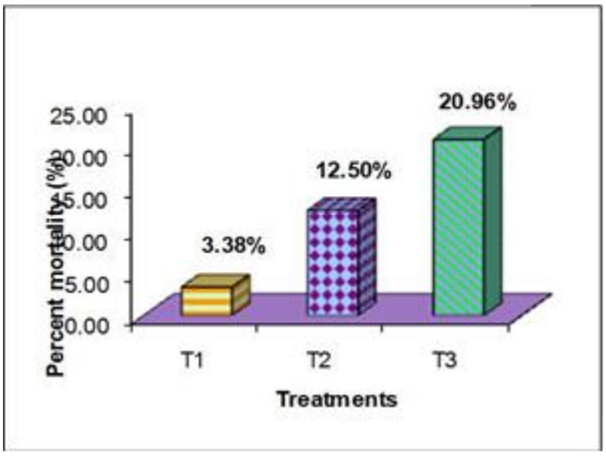

Figure 8. Comparison of the percent mortality of tilapia fry in different treatments during the study period.

DISCUSSION

Nile tilapia is known to tolerate high temperature. It cannot tolerate for a long period water temperature between 10 and 15°C (Ballarin and Hatton, 1979), and does not survive below 10^{o}C (Chervinski and Lahav, 1976). In warm water fish maximal metabolic rate was observed at temperature range from 30 – 35^{o}C. During the present study, the water temperatures of the ponds were found between 30 to 34.3°C. Aminul (1996) stated that the water temperature ranged from 29 to 35°C is suitable for culture of fish.

During the experimental period dissolved oxygen content of the ponds was found between 4.80 to 5.40 mg/L. According to Rahman (1992) dissolved oxygen content of a productive pond should be 5ppm or more. Dissolved oxygen contents of experimental ponds was slightly low due to data taken at 9.00 to 11.00.

During the experimental period pH values of most of the ponds were slightly alkaline which indicated good environmental conditions for fish culture. Fluctuations of the pH values of the experimental ponds were ranged from 7.6 to 8.3. Banerjea (1967) observed that average fish production might be expected in the pH range of 7.5 to 8.5.

Secchi disc reading about 12 to 19 cm means the water body is productive. The ponds were newly made, so the water was slightly turbid. Kabir (2003) and Chowdhury (2005) recorded almost similar transparency values of pond water of the present experiments.

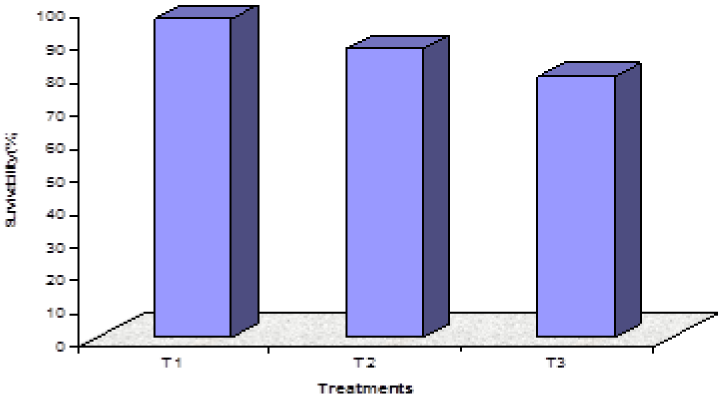

Figure 9. Comparison of the survival rate (%) of mono-sex tilapia in different treatments during study period

Growth, mortality, survivability and production performances

Mean weight gain

There was significant difference ($p<0.01$) among the different treatments. The highest mean weight gain (1345.00±5.00) was found in treatment T_2, whereas the lowest mean weight gain (1148.00±2.00g) was found in treatment T_1. The result indicated that the growth rates varied in different stocking density which coincides with the findings of Begum (2009), Rubel (2008), Rashid (2008), Islam (2007), Shaha (2004) and Roy (2002). The highest mean weight was found in treatment T_3 might be due to low stocking density, proper utilization of hormon mixed formulated feed and natural food.

Percent mean weight gain

There were significant differences ($p<0.01$) found among the three different treatments. The highest mean value (2445.45±9.09) of percent weight gain was found in T_2 whereas the lowest mean value (1800.00±3.08) found in T_3. The result indicated that the growth rates varied due to different stocking densities which coincides with the findings of Begum (2009), Rubel (2008), Rashid (2008) and Islam (2007). The percent weight gain of the present study was lower than findings this might be due to initial size of the spawn released in the ponds and the difference in the culture system.

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Specific growth rate (SGR) percent per day

The mean specific growth rate of mono-sex male tilapia spawn was observed as 10.52%, 11.56% and 10.52% in T_1 T_2 and T_3, respectively (Table 4). There were significant differences ($p<0 .01$) among the different treatments. Islam (2007) and Alam (2009) obtained the highest values of specific growth rate at lowest stocking densities. The difference of SGR values of *O. niloticus* in the present study might be due to the temperature difference and natural productivity of the ponds. The other reason might be due to the initial size difference of *O. niloticus* used for experiment and also might be due to the difference of culture season.

Mortality and percent mortality

After rearing 28 days the highest mean mortality (1048±15.00) was found in T_3, whereas as the lowest mean mortality (152.00±2.00) was found in treatment T_1. The result indicated that the mortality varied in respect to different stocking densities, temperature and various environmental factors which coincides with the findings of Begum (2009), Rubel (2008), Rashid (2008), Islam (2007).

The values of mortality were recorded as 3.38, 12.50 and 20.96% in T_1, T_2 and T_3, respectively. Mortality rate was found to be negatively influenced by different stocking densities i.e. the lowest stocking density showed lowest mortality and highest stocking density showed highed mortaliy.

Survival rate (%)

The values of survivability were recorded as 96.62, 87.50 and 79.04% in T_1, T_2 and T_3, respectively. The highest survivability (96.62%) was found in treatment T_1 whereas the lowest survivability (79.04%) was found in T_3. A similar survival rate was observed by Hasan (2007) and Begum (2009) who recorded survival rate ranged from 79.44 to 89.83% and 84 to 92%, respectively which has the similarity with the present results.

Production (kg/hapa/28 days)

The highest production was found 5.252 kg/hapa/28days from T_1 whereas the lowest production was found 4.881 kg/hapa/28days from T_2. Although the mean weight gain in T_1 was highest but total production was highest in T_2 which might be due to higher number of fishes. The present result supports the findings of Hasan (2007) and Begum (2009) who achived the best production from higher stocking densities compared to that achieved with the lower ones.

SUMMARY AND CONCLUSION

The study was conducted to study on stocking density of hormone treated tilapia *(Oreochromis niloticus*) fry in three hapas in a pond for a period of 28. Three stocking densities were used under three different treatments viz. 4000 fry/hapa in treatment T_1, 4500 fry/hapa in T_2 and 5000 fry/hapa in T_3. To estimate mortality fries were reared with feed and sampling was done at an interval of seven days. Four stages of eggs were found where stage one was rejected for low hatching rate and stage four was rejected for taking natural food. The water quality parameters such as temperature, dissolved oxygen and pH, it were monitored at an interval of seven days. The ranges of water quality parameters were, temperature 32 to 34.3°C, dissolved oxygen 4.8 to 5.4, pH 7.6 to 8.3 and transparency 12 to 19 cm. All the values of such parameters were within limit of good aquaculture water quality. No significant variations of water quality were observed among different treatments and all the values were within the acceptable and suitable levels for tilapia culture.

Under the experimental conditions, different treatments showed different growth rates. In the present study, the mean weight gain was significantly higher in T_2 (1345.00a±5.00g) followed by T_3 (1170±2.00g) and then T_1 (1148.00±2.00g). The SGR of T_2 (11.56) was significantly ($P<0.01$) higher than that of T_1 (10.72) and T_3 (10.52).

The values of mortality were recorded as 3.38%, 12.50% and 20.96% in treatments T_1, T_2 and T_3, respectively. The highest mortality 20.96% was found in treatment T_3 whereas the lowest mortality 3.38% was found in T_1.

Stocking density is an important parameter in fish culture as it has direct effect on the growth, production and increase mortality. The highest production was found 5.252 kg/hapa/28days from T_1 whereas the lowest production was found 4.881 kg/hapa/28days in T_2.

Based on the findings of the present experiment, it can be concluded that the optimum stocking density of hormone treated tilapia was found to be 4000 fry/hapa/28days to make all male population where lowest mortality, highest growth and survival was found as compared with others. For better aquaculture benefit mass production of all male mono-sex tilapia related research including the quality of egg and spawn should be conducted through longer period of investigation in the country.

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