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Comparative Study of Monosex Tilapia (Oreochromis niloticus) Production under Different Stocking Density in Ponds

M.S.Reza M. A. Rahman U. A. Janifa M. R. Hasan P. Sarker
Department of Aquaculture, Faculty of Fisheries, Bangladesh Agricultural University, Mymesnsingh-2202, Bangladesh
Email:rm.ashique08@gmail.com

Abstract
A field experiment was conducted to study the effect of stocking density on the growth and production of monosex male tilapia (*Oreochromis niloticus L.)* conducted in six ponds commencing from 7th July to 4th November, 2012. Feeding frequency were two times in a day. The mean initial weight of fry in all the treatments were 5.7±0.04 g and after completion of the experiment the mean final weight of tilapia was 321.62±1.11 g for T_1, 300.12±0.87 g for T_2 and 256.25±2.38 g for T_3. The mean weight gain of 315.92±1.11, 294.42±0.87 and 250.552.38g and mean percent weight gain of 5542.40, 5165.20 and 4395.61% and mean FCR was 1.41±0.00, 1.46±0.01 and 1.59±0.00and mean SGRof 3.36, 3.30 and 3.17% and the survival rate was 97.67, 94.25 and 93.40% were recorded in T_1, T_2 and T_3, respectively. The highest weight gain, percent weight gain, SGR and survival rate were found in T_1 and lowest were found in T_3. The production was observed to be 47.12±0.52, 56.57±0.80 and 59.84±1.10 kg/dec/4 months in T_1, T_2 and T_3, respectively. The significant ($P<0.01$) highest fish production and FCR was obtained 59.84 kg/dec/4 months and 1.59 respectively in T_3 under stocking density was 250 fish/decimal and production, FCR was found to be decreased significantly with the decrease in stocking density. The lowest fish production 47.12 kg/dec/4 months were observed in T_1. Although higher production was obtained in T_3 but individually growth performance of monosex tilapia was higher in T_1.
Keywords: Monosex tilapia, growth performance, stocking density, tilapia production.

Introduction

Fish contributes a significant amount of animal protein to the diets of people in Bangladesh, about 63% of which comes from aquatic animals. At present, aquaculture production accounts for about one-third of the total fish production in Bangladesh (DoF, 2011). Tilapia is a significant food fish in many tropical and sub-tropical countries and one of the first fish species that was cultured in the world (Pompa and Masser, 1999). It is considered suitable for culture because of high tolerance to hostile environmental conditions, relatively fast growth and the ease with which they can be bred. It provides one of the most important sources of animal protein and income throughout the world (Sosa *et al*., 2005). The stocking density is the major concern for mono-culture. Sometimes excellent fish fry do not perform satisfactory growth unless correct stocking practices (Sanches*et al*., 1999). In general the stocking density and growth of fish are very much related. The optimum stocking density ensures sustainable aquaculture providing proper utilization of feed, maximum production, sound environment and health. In comparison to low stocking density, high stocking density exerts many negative impacts such as competition for food and shelter and rapid outbreak of disease if occurred. Therefore, it is important to optimize the stocking density for the target species in aquaculture for desired level of production. Tilapia has good resistance to poor water quality and disease, tolerance to a wide range of environmental conditions, ability to convert efficiently the organic and domestic waste into high quality protein, rapid growth rate and good flavor (Ballarin and Hallar, 1987). Tilapias are currently having important impacts on poor people in developing countries, both as cultured species in household-management systems and through access to fish produced in informal and formal fisheries (Edwards, 2003; and Little, 2003). But the culture practice of tilapia varies to a great extent from country to country and even among the different farming systems
The experiment was conducted with the following objective:

- To study the growth performance of monosex male tilapia under different stocking density; and
- To determine the suitable stocking density for culture of tilapia in ponds.

Materials and methods

Study area and pond facilities

The experiment was conducted in Reliance Aqua Farms which is situated in Rahmatpur, Sadar, Mymensingh owned by HriteshPandit. The experiment was carried out in six similar ponds i.e.; the size, depth, basin configuration and water supply facilities were almost same of all ponds. The size of each pond was 25 decimal and the shape was rectangular.

Experimental protocol

The experiment was carried out commencing from 7th July to 4th November, 2012. The study was conducted

with the fry of monosex male tilapia (*Oreochromis niloticus L.)*. The weight of each fry 5.7 g was stocked to study the effect of stocking density on the growth of monosex male tilapia.

Experimental design

Monosex male tilapia *(O. niloticus)* fry was stocked as experimental species. Ponds were divided into three treatments Viz. T_1, T_2, and T_3 each having two replications, for stocking fish at 150 fry/decimal, 200 fry/decimal and 250 fry/decimal, respectively. The size of the each pond was 25 decimal. A complete layout of the experiment is shown in table 1.

Table1. Lay out of the experiment

Treatment	Replication	Average size of fish	Stocking density Fry/dec
T1	R1	5.7 g	150
	R2	5.7 g	150
T2	R1	5.7 g	200
	R2	5.7 g	200
T3	R1	5.7 g	250
	R2	5.7 g	250

Fry collection and stocking

The fries of tilapia, *Oreochromis niloticus* were collected from Reliance Hatchery, Trishal, Mymensingh. The fries were kept in a nursery pond at a high stocking density. After three days later fries were transferred to the experimental grow out ponds. The average weight of each fry was 5.7 g. The stocking densities of fries were 150/decimal, 200/decimal and 250/decimal in T_1, T_2 and T_3 respectively. Proper methods and hygienic conditions were maintained during release the fry into the ponds.

Feeding

The feeds were applied at the rate of 5% of body weight at the beginning of the experiment. Then it was reduced to 4% after one month and it was further reduced to 3% after 2nd month and thence to end of the experiment. Feeds were applied twice a day, half in the morning (8.00 am) and the rest in the afternoon (4.00 pm). Mainly the MEGA fish feed was used throughout the experimental period.

Sampling procedure

Sampling of the experimental fish was done randomly at an interval of 15 days by using seine net and scoop net in order to check the growth performance of fish and also adjust the feeding rate. Growth of fish in each sampling was taken by weight of fish. Weight of sampling fish was

Water quality parameters

Water quality parameters were monitored every 15 days interval throughout the experimental period to maintain the proper environment of experimental ponds for fish. Important water quality parameters such as dissolved oxygen, water temperature and pH were monitored throughout the experimental period.

Estimation of the growth parameters of fishes

Data collected during growth trials and subsequent analysis of data was used to determine the growth trials in different treatments were calculated by using following parameters.

Weight gain (g)

Weight gain (g) = Mean final fish weight (g) — mean initial fish weight (g)

Percent weight gain

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

Specific growth rate (SGR %/day)

Specific growth rate (SGR) is the instantaneous change in weight of fish calculated as the percent of increase body weight per day over the experimental period. SGR was calculated by using following formula-

$$\text{SGR (\% per day)} = \frac{\log_e W_2 - \log_e W_1}{T_2 - T_1} \times 100$$

Where,

W_1 = The initial body weight (g) at time T_1 (day)

W_2 = The final live body gain (g) at time T_2 (day)

Food Conversion Ratio (FCR)
The food conversion ratio is expressed by the amount of food consumed to the weight gain was determined for each of the three treatments. It was calculated as:

$$FCR = \frac{\text{Feed fed (dry weight)}}{\text{Live weight gain}}$$

Survivability (%)

$$\text{Survivability (\%)} = \frac{\text{No. of fish harvested}}{\text{No. of fish stocked}} \times 100$$

Production (kg/dec/4 months)
At the end of the experiments, most of the fishes were caught by net and the rest by draining out the ponds. It was calculated as:
Production = No. of fish harvested × Average final weight of fish (g)

Statistical analysis
One way analysis of variance (ANOVA) was used to determine the effect of stocking density on the growth of monosex tilapia in different treatments. For this purpose the present data were converted to arcsine and then applied for analysis. This was followed by Duncans New Multiple Range Test (DMRT), to identify the level of significance of variance among the treatments. Computer analysis of data was done by using the software SPSS program and MS excel program.

Economical analysis
A simple economical analysis was performed to estimate the net profit of cultured monosex tilapia. The cost of feed was BDT 44/ kg.

Results and discussions

Growth performance of fish
After ending the experiment the data were analyzed and the growth parameters of monosex tilapia in different stocking density were shown in graphically.

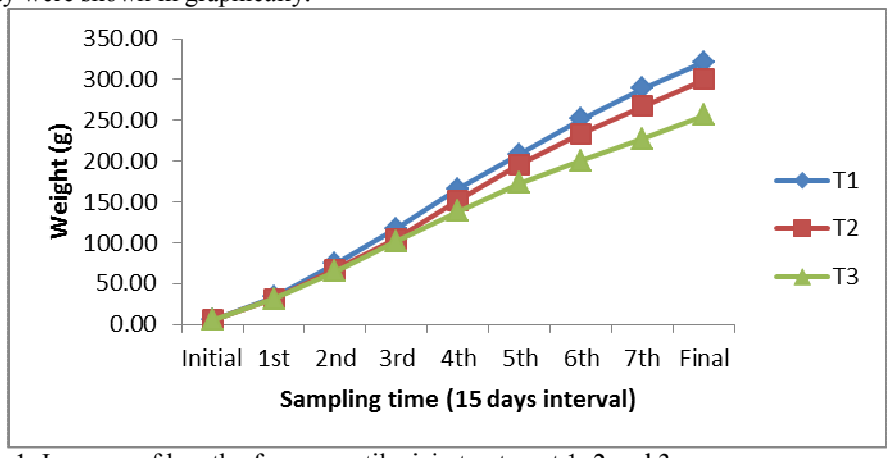

Figure 1: Increase of length of monosextilapiain treatment 1, 2 and 3.

Percent weight gain (%)
There was no significant ($p<0.01$) difference in initial weight of fish in different treatment. The percent weight gain of fish was 5542.40(±19.44), 5165.20(±15.30) and 4395.61(±41.76)% forT_1, T_2 and T_3, respectively. The significant ($P<0.01$) highest percent weight gain (5542.40%) was observed in T_1 having stocking density 150 fish/decimal. The minimum percent weight gain (4395.61%) was observed in T_3 having stocking density 250 fish/decimal.

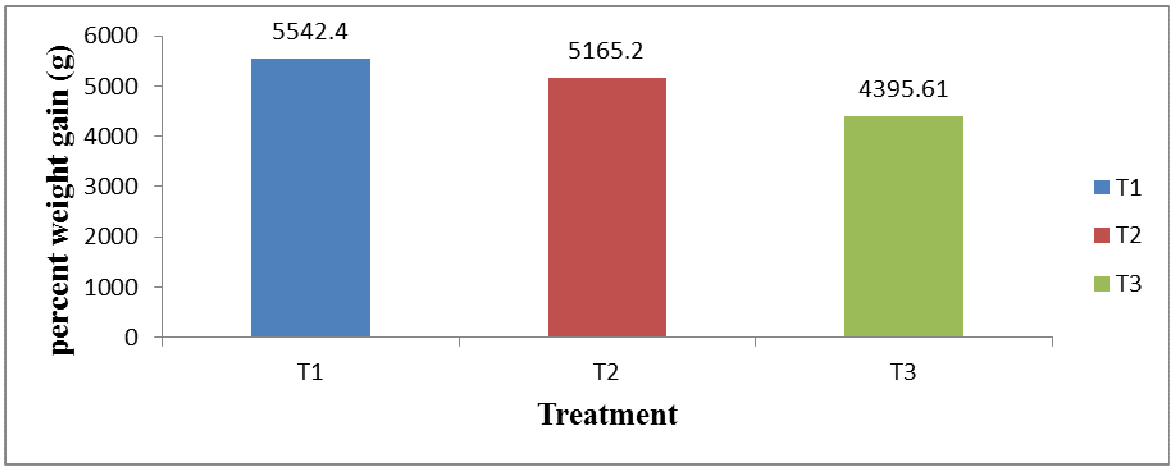

Figure 2: Effects of different stocking density on percent weight gain of monosex tilapia.

Specific growth rate (SGR % per day)

The values of specific growth rate of monosex tilapia were observed as, 3.36±0.00,3.30±0.00 and3.17±0.01 in treatment T_1, T_2 and T_3, respectively. There were significant ($P<0.01$) differences among the different treatments. SGR progressively increased with the decrease in stocking density. The significant highest specific growth rate (3.36) was observed in T_1. The lowest specific growth rate (3.17) was observed in T_3.

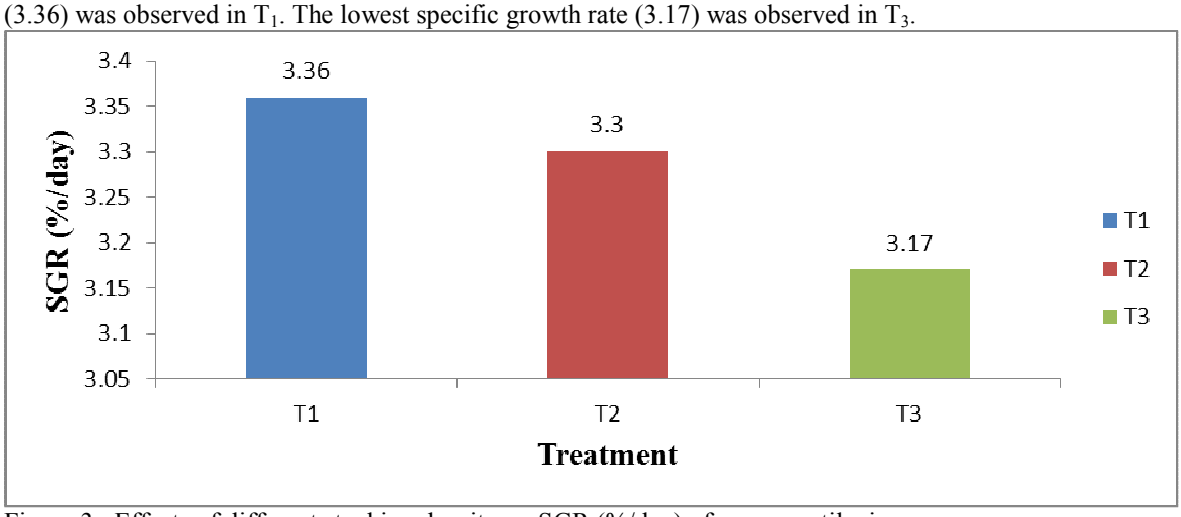

Figure 3:. Effects of different stocking density on SGR (%/day) of monosex tilapia

Food Conversion Ratio (FCR)

The FCR was observed to be1.41±0.00, 1.46±0.01and 1.59±0.00 in T_1, T_2 and T_3, respectively. The significant ($P<0.01$) highest FCR was obtained in T_3 under stocking density 250 fish/decimal and FCR was found to be decreased significantly with the decrease stocking. The lowest FCR was observed in T_1 under stocking density 150 fish/decimal.

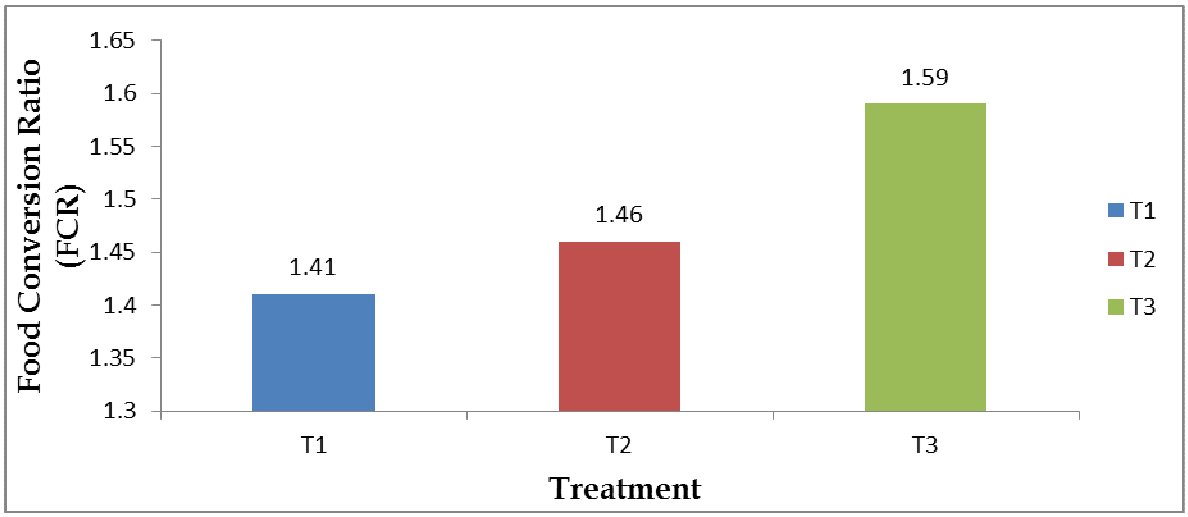

Figure 6.Effects of different stocking density on food conversion ratio (FCR) of monosex tilapia under field trial.

Survivability (%)

The survivability of monosex tilapia was observed as 97.67±1.41, 94.25±1.06 and 93.40±0.85% in T_1, T_2 and T_3, respectively. The highest survivability was recorded in treatment T_1 and the lowest survivability was in T_3. The little variation of survivability was occurred due to environmental condition and stocking density. In T_1 stocking density was 150 fish/decimal and the survivability was high and in T_3 stocking density was 250 fish/decimal and the survivability was low. So it is said that, the lower the stocking density the higher the survivability.

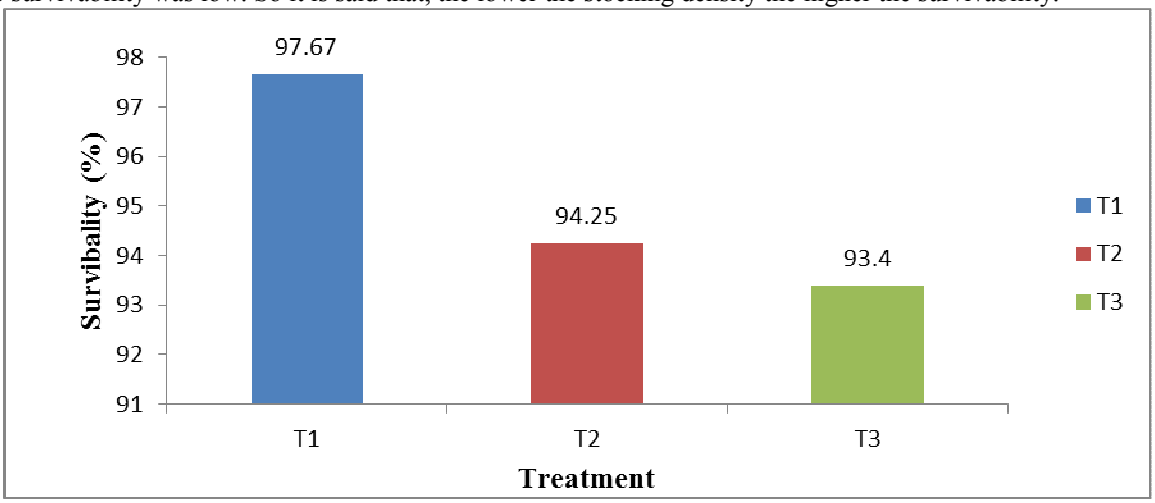

Figure 7.Effects of different stocking density on survival of monosex tilapia under field trial.

Production (kg/dec/4 months)

The production was observed to be47.12±0.52, 56.57±0.80and 59.84±1.10 kg/dec/4 months in T_1, T_2 and T_3, respectively. The significant ($P<0.01$) highest fish production was obtained 59.84±1.10 kg/dec/4 months in T_3 under stocking density 250 fish/decimal and production was found to be decreased significantly with the decrease stocking. The fish production 47.12±0.52 kg/dec/4 months was observed in T_1 under stocking density 150 fish/decimal.

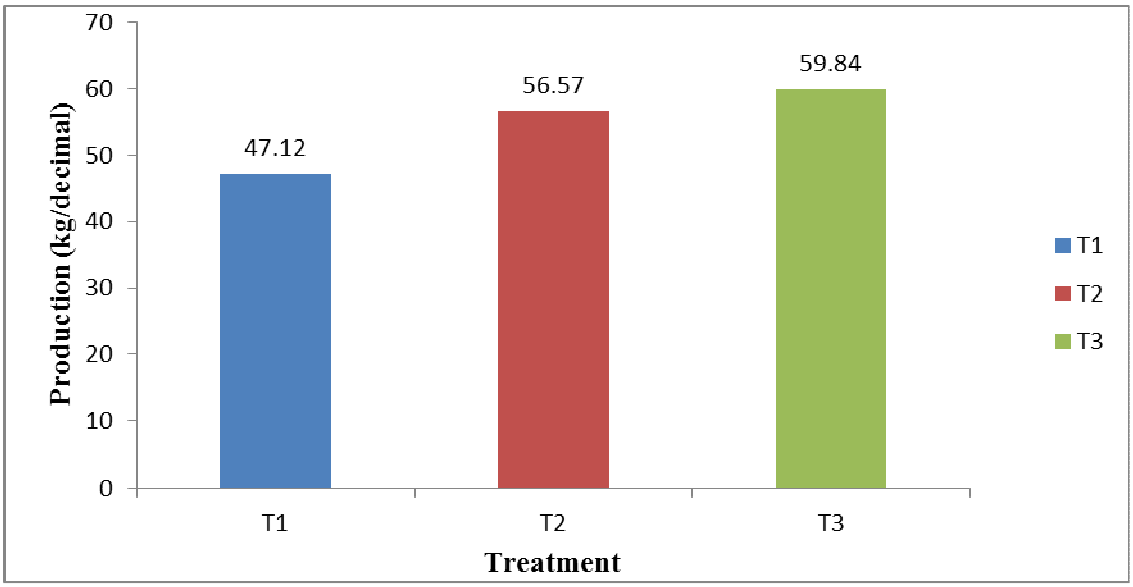

Figure 8.Effects of different stocking density.production (kg/dec/4 months) of monosex tilapia under field trial.

Net profit

Net profits BDT/decimal were 1133, 1343 and 1070 in T_1, T_2 and T_3 respectively (Table 7). In case of T_3 the gross income was highest and the total cost also highest. For this the net profit was lowest in case of T_3. On the other hand net profit was highest in T_2 due to the low cost and more production.

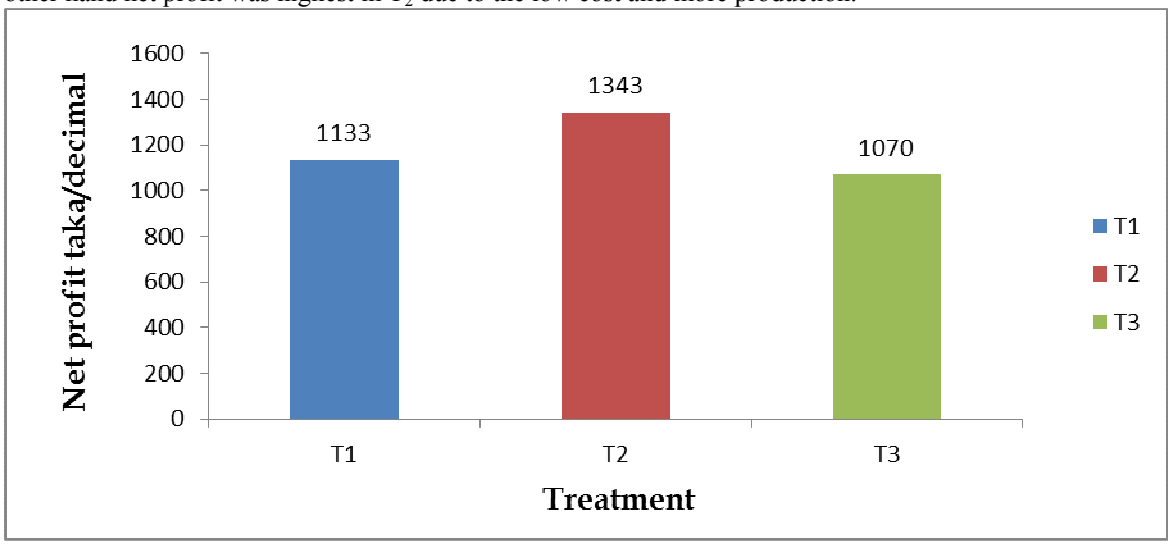

Figure 12.Net profit in different treatments during the study period.

Growth performances

Growth performance of monosex male tilapia in terms of weight gain under different stocking density for a period of four months (7th July to 4th November 2012) is presented in different treatments during experimental period, final weight of fish, % weight gain, SGR (% per day), survival (%) and total fish production (kg/dec/4 months) were calculated which are discussed below:

Percent weight gain

There was no significant ($p<0.01$) difference in initial weight of fish in different treatment. The percent weight gain of fish was 5542.40±19.44, 5165.20±15.30 and 4395.61±41.76% for T_1, T_2 and T_3, respectively. The significant ($P<0.01$) highest percent weight gain (5542.40%) was observed in T_1 having stocking density 150 fish/decimal. The minimum percent weight gain (4395.61%) was observed in T_3 stocking density 250 fish/decimal. The results indicated that the percent weight gain varied in different stocking densities which coincides with the findings of Rahim (2010). He found percent weight gain ranged from 3971 to 5415 %.

Specific growth rate (SGR) (% per day)
The values of specific growth rate of monosex tilapia were observed as 3.36±0.00, 3.30±0.00 and 3.17±0.01 in treatment T_1, T_2 and T_3, respectively. There were significant ($P<0.01$) differences among the different treatments. SGR progressively increased with the decrease in stocking density. The significant highest specific growth rate (3.36) was observed in T_1. The lowest specific growth rate (3.17) was observed in T_3. Islam (2007), Begum (2009) and Rahim (2010) who recorded specific growth rate ranged 2.36 to 2.65%, 3.65 to 3.79% and 3.09 to 3.34%. They obtained the highest values of specific growth rate at lowest stocking densities. Hossain (2007) achieved the specific growth rate ranged between 3.14% and 3.32%.

Food Conversion Ratio (FCR)
The values of FCR of monosex tilapia were observed to be 1.41±0.00, 1.46±0.01 and 1.59±0.00 in T_1, T_2 and T_3, respectively. The significant ($P<0.01$) highest FCR was obtained in T_3 under stocking density was 250 fish/ decimal and FCR was found to be decreased significantly with the decrease stocking. The lowest FCR was observed in T_1 under stocking density was 150 fish/decimal.Hossain (2007), Rahim (2010) recorded FCR highest in higher stocking density and FCR lowest in lower stocking density.

Survivability (%)
The survivability of monosex tilapia were observed as 97.67±1.41, 94.25±1.06 and 93.40±0.85% in T_1, T_2 and T_3, respectively. The highest survivability was recorded in T_1 and the lowest survivability was in T_3. The little variation of survivability was occurred due to environmental condition, high competition for food and space among the fish. A more or less similar survivability was observed by Rahman (2000) who recorded survival rate ranged from 94 to 96% in semi intensive culture of tilapia.

Production (kg/dec/ 4 months)
The highest production was observed 47.12±0.52, 56.57±0.80 and 59.84±1.10 kg/dec/4 months in T_1, T_2 and T_3, respectively. Although the mean weight gain (g) in T_1 was highest but total production was highest in T_3 which might be due to higher number of fishes. The present result supports the findings of Begum (2009) and Rahim (2010) who achieved the best production from higher stocking densities compared to that achieved with the lower ones.

Economical analysis
From the experiment it was found that the highest net profit was BDT 1343 in T2. That time the market price was BDT 100/kg fish. Culture of monosex tilapia *(Oreochromisniloticus)* at stocking density (200 fish/dec) shown higher benefit. The similar result was found by Karim (2006), Alim (2013).

Conclusions
During the experimental period, three stocking density were applied to observe the growth performance of tilapia. The mean initial weight of fry in all the treatment was 5.7 g and after completion of the experiment the mean final weight of tilapia were 321.62 g for T_1, 300.12 g for T_2 and 256.25 g for T_3. The mean weight gain of 315.92, 294.42and 250.55 g and mean percent weight gain of 5542.40, 5165.20 and 4395.61% and mean SGRof 3.36, 3.30 and 3.17% and the survival rate was 97.67, 94.25 and 93.40% were recorded in T_1, T_2 and T_3, respectively. The highest weight gain, percent weight gain, SGR, and survival rate were found in T_1 having the stocking density 150 fish/decimal and lowest were found in T_3 having stocking density 250 fish/decimal. The production were observed to be 47.12, 56.57 and 59.84 kg/dec/4 months and FCR was 1.41, 1.46 and 1.59 in T_1, T_2 and T_3, respectively. The significantly ($P<0.01$) highest fish production was obtained 59.84 kg/dec/4 months in T_3 under stocking density 250 fish/decimal and production was found to be decreased significantly with the decrease in stocking densities. The lowest fish production 47.12 kg/dec/4 months and lowest FCR were observed in T_1 under stocking density 150 fish/decimal. The net profit observed significantly highest in T_2 under stocking density 200 fish/decimal and the profit observed lowest in T_3 under stocking density 250 fish/decimal. Based on the present experimental condition, it can be recommended that the stocking density for monosex tilapia 200 fish /decimal is best for better production.

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