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Research Article

# Growth, survival and production of indigenous endangered fish *Ompok pabda* at different stocking densities in primary nursing

M. Anamul Haque[1], M. A. Baker Siddique[2], M. Rafiqul Azam[3], S. Monira Shanta[4], A. Ahmed Nishat[4], Rafiul Islam[4], M. Fazla Rabbi[4], Sonya Mrong[4], M. Ashik Ullah[4] and M. Rafiqur Rahman[4*]

[1]*Spectra Hexa Feeds Limited, House 17, Road # 106, Gulshan-2, Dhaka, Bangladesh*
[2]*Symbiosis Bangladesh, House # 5/A, Road # 136-137, Gulshan-1, Dhaka-1212, Bangladesh*
[3]*Department of Fisheries, Ministry of Fisheries and Livestock, Dhaka, Bangladesh*
[4]*Department of Fisheries Biology and Genetics, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh*

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***CORRESPONDENCE**
mrafiqurrahman@yahoo.com

**ABSTRACT**

This study focused on the development of nursing protocol of endangered fish species, Pabda Catfish *Ompok pabda* in nursery ponds to estimate the growth, survival and production. The experiment was conducted in six nursery ponds of 4.0 decimal (0.016 ha) each stocked with 5 days old fry of pabda cultured over a period of 4 weeks from 01 April 2018 to 28 April 2018. The stocking density was 2.0, 2.5 and 3.0 million/ha in T1, T2 and T3, respectively. The commercially available Quality pre-nursery and nursery feeds were given three times daily at the rate of 15% for the first one week and were decreased by 1% consistently from there on. Highest growth performance was recorded where the stocking density was lowest. Similar result was observed in survival rate which were 57.57, 51.43 and 45.68% where stocking densities were 2.0, 2.5 and 3.0 million fry ha$^{-1}$. The final mean length of 3.35±0.39 cm, 3.01±0.31cm and 2.47±0.19 cm and weight of 3.71±0.42 g, 3.28±0.13 g and 2.66±0.36 g were obtained at 2.0, 2.5 and 3.0 million fry/ ha stocking densities, respectively. The growth performances and survival of pabda fry were significantly higher ($p < 0.05$) in T1 than those obtained from T2 and T3, respectively. But the highest gross and net production was recorded in T2 where the stocking density was 2.5 0 million fry/ha. So, the stocking density of 2.5 million fry/ ha showed the best performance in primary nursing which a better production to fish farmers but more research still needed to further optimize stocking density of *O. pabda* for primary nursing.



## INTRODUCTION

*Ompok pabda* (Hamilton) is a member of the family Siluridae under the order Siluriformes which is commonly known "Pabda" or "Pabo" and well known as freshwater silurid catfish. It has found in India, Afghanistan, Pakistan, Bangladesh and Myanmar (Jayaram, 2009). It is geographically distributed in muddy rivers, floodplains, swamps, streams and canals in Bangladesh, India, Burma Pakistan and Afghanistan (Rahman, 2005) and is commonly distributed in natural water bodies like rivers, lakes and flood plains (Hussain, 2006; Chakraborti *et al.*, 2012). It has great demand to the consumers and high price in the market because of its luscious taste. A very few research has been carried out so far on food and feeding habit of *O. pabda*. Some studies have reported it as a carnivorous species (Parameswaran *et al.*, 1971; Chakrabarti *et al.*, 2012) while in contradiction some others have documented its omnivorous feeding habit and likes to eat small fishes, protozoans, crustaceans, algae, insects and debris (Bhuiyan and Islam, 1991; Taleb *et al.*, 1991). Banik *et al.*, (2012) have reported that, at the first maturity for male and female of *O. pabda* attained 16.3 cm and 17 cm as length, respectively. The breeding season generally occurred from June to September. The fecundity was found to vary from 2460 to 5986 nos., with mean of 4330±799 for the fish with total length of 11.5-20.0 cm (Gupta *et al.*, 2014). The breeding season of *O. pabda* have reported May to July (Siddiqui, 1996) while Akhteruzzaman *et al.*, (1993) and Chakraborty *et al.*, (2010) have reported May to August.

Pabda Catfish were abundant in the natural water bodies of Bangladesh, but their availability, as for many other fish species, has declined due to the destruction of natural breeding and feeding grounds (Mazid and Kohinoor 2003; Ali *et al.*, 2018)). These factors not only destroyed the breeding grounds but also caused havoc to the availability of this important fish and thus, it has become gradually endangered (Akhteruzzaman *et al.,* 1993; Kohinoor *et al.,* 1997 Hussain and Hossain, 1999; Rahman *at el.,* 2008). These unfavorable interventions have endangered the Pabda Catfish; it is now on the red list of threatened fishes of Bangladesh (Islam et al. 2002). It is feared that this fish will be extinct in the near future if no conservation attempt is taken. In order to protect this fish from extinction as well as its conservation and rehabilitation, development of appropriate techniques for breeding and rearing of fry is very essential. Akhteruzzaman *et al.,* (1993) developed a viable induced breeding technique of pond-reared pabda for the first time in Bangladesh.

The major impediment in the development of any aquaculture system, one of the obstacles to overcome is the availability of the fry and fingerlings (Webber and Riordan, 1976). Survival of the fry and its rearing up to a size suitable for stocking is a great problem. Not only fish but also pearl spot (*Etroplus suratensis*) culture is greatly hampered due to its sustainable seed production (Selvaraj *et al.,* 2016). However, survival and growth of fry depends on stocking densities, type and quality of supplementary feeds (Debnath et al, 2016). For earthen pond fish production, fish farmers use both commercial and farm-made fish diets for maximum production of fish (Ananai *et al.,* 2017). In order to obtain maximum production, it will be necessary to stock the ponds at appropriate stocking densities for optimum survival and growth of fry. Therefore, the present experiment has been carried out to standardize appropriate stocking densities in respect to the growth, survival and production of *O. pabda* fry in our country context.

## MATERIALS AND METHODS

The experiment was carried out for 4 weeks from 1 April 2018 to 28 April, 2018 in six earthen nursery ponds situated near Bangladesh Agricultural University Campus, Mymensingh, Bangladesh. The ponds were rectangular shape covering the surface 4.0 decimal (0.016 ha) each. The average water depth of each pond was 3 feet. Before stocking ponds were dried and remove all aquatic vegetations possible. After drying, ponds were liming with quicklime (CaO) at the rate of 1 kg per for killing harmful pathogens. After that, all the ponds were filled with ground water up to 3 feet of water level. Five days subsequent to liming, the ponds were manured with cattle dung at the rate of 10 kg per decimal. Seven days after manuring, the pond water was treated with dipterex (1.0 ppm) to eradicate harmful insects and predatory zooplankton. One day after applying the dipterex, all the experimental ponds were stocked with 5-days old fry of *O. pabda* having an average length of 1.13±0.02 cm and weight of 0.0006±0 g. Three treatments were designed with different stocking densities of fry viz., 2.0 million/ha (T1), 2.5 million/ha (T2) and 3.0 million/ha (T3) having with two replicates each. One day after stocking, the fry were fed three times in a day with Quality pre nursery feed which containing 43% crude protein for the first one week. The rest of three weeks have been used Quality nursery feed which containing 40% protein. The rate of feeding was 15% of the estimated body weight of fry for the first week, 14% for the second week, 13% for the third week and 12% for the fourth week. The fry were sampled weekly by seining with a fine-meshed net for the measurement of growth, to check up the health condition and feed adjustment. There are two types of commercial quality fish feeds were used in this experiments which were purchased from local dealer of Quality feed seller. Proximate composition of the feeds (moisture, protein, lipid, carbohydrate, ash and fiber) was analyzed according to AOAC (1984) method. Proximate composition of experimental feeds is shown in Table 1.

The water quality parameters of pond water were monitored weekly between 09.00 and 10.00 am. Temperature (ºC) and dissolved oxygen (mg/l) were determined directly by a digital water quality analyzer Hanna DO meter (Model-HI 9146, Romania), pH by a digital pH-meter (Milwaukee pH meter, Model-PH55/PH56, USA), and transparency (cm) by a secchi disc and ammonia nitrogen by a UV VIS Spectrophotometer water analysis kit (DR 6000TM, USA). Total alkalinity was estimated following the standard method (Stirling, 1985; APHA, 1992).

The plankton biomasses were recorded weekly. For qualitative and quantitative estimates of the plankton, ten liters of water were collected from different locations and depths of each pond and were filtered through fine-meshed plankton net (25 μm) to obtain a 50 ml sample. The samples were preserved immediately with 5% buffered formalin in plastic bottles. Plankton density was estimated by using a sub-sampling technique. A Sedgwick-Rafter (S-R) cell was used under a calibrated compound microscope for plankton counting. Plankton cells in 10 randomly chosen squares were counted for quantitative estimation using the formula proposed by Rahman (1992). After 4 weeks of nursing, the fry were harvested by repeated netting. The collected fingerlings were counted and weighed individually to estimate the survival rate and production and compared them among the treatments.

The collected data for growth, survival, production, water quality parameters and plankton abundance of different treatments were tested using one-way analysis of variance (ANOVA) followed by Duncan's Multiple Range Test (Duncan, 1955). The level for statistical significance was set at 0.05%

## RESULTS

The mean values of water quality parameters in the experimental ponds were recorded during the study period and presented in Table 2. The mean water temperatures were 29.98±1.55, 30.88±1.34 and 30.89±1.22 ºC in T1, T2 and T3, respectively but did not differ significantly ($p > 0.05$) among the treatments. The mean values of Dissolved Oxygen were 6.01±0.89 (T1), 5.11±0.57 (T2) and 4.23±0.74 mg/l (T3) which showed significant difference ($p < 0.05$) among the treatments. The mean values of pH were recorded 7.24±0.91, 7.59±0.32 and 7.93±0.81 in T1, T2 and T3, respectively but did not differ significantly ($p > 0.05$). The transparencies of pond water were 31.16±3.25, 39.68±2.22 and 47.54±5.31 cm in T1, T2 and T3, respectively. The significantly differed transparency was observed among the treatments. The mean value of total alkalinity was recorded 141.26±10.25, 136.29±11.57 and 134.55±12.87 mg/l in T1, T2 and T3, respectively. The highest alkalinity was recorded in T1 and Lowest in T3. The mean values of ammonium-nitrogen (NH4-N) in T3 (0.09±0.02 $mgl^{-1}$) was significantly ($p < 0.05$) higher than other treatments. However, the lower mean values of ammonium-nitrogen (NH4-N) were recorded in T3 (0.04±0.02).

The mean plankton abundances in experimental ponds during the experimental period are summarized in Table 3. There are four genera of plankton groups were identified in the experimental pond such as Bacillariophyceae, Chlorophyceae, Cyanophyceae and Euglenophyceae whereas the zooplankton population was comprised only two groups- Crustacea and Rotifera. Phytoplankton of Chlorophyceae group was the most dominant and Euglenophyceae group was the least abundant as observed during the study period. Zooplankton of Rotifera group was the most dominant in terms of both numbers and genera compared to Crustacean group among the treatments. The total phytoplankton was found 12063 ± 316, 9709 ± 292 and 7558 ± 314 cells/l in T1, T2 and T3 whereas the total abundance of zooplankton were 5940 ± 306, 5140 ± 335 and 4264 ± 310 cells/l in T1, T2 and T3, respectively. The mean abundance of both phytoplankton and zooplankton also showed statistically significant ($p < 0.05$) among the treatments.

The growth (in length and weight) and survival of *O. pabda* in different treatments were recorded during the experimental period and summarized in Table 4 and Fig. (1 & 2). At the stocking time, the initial length and weight of fry stocked in all the ponds were same i.e. 1.13±0.02 cm and 0.0006±0 g. The average final length and weight were recorded 3.35±0.39 cm and 3.71±0.42 g, 3.01±0.31 cm and 3.54±0.13 g and 2.47±0.19 cm and 2.66±0.36 g in T1, T2 and T3, respectively. The highest mean final weight was also obtained in T1 and lowest in T3. However, the mean final length and weight were showed significant difference ($p < 0.05$) in T1 followed by T2 and T3, when ANOVA was performed. The survival rate was 57.57±2.06, 51.43±0.81 and 45.68±0.89 in T1, T2 and T3, respectively. The highest survival rate was found in where stocking density comparatively was lower. However, the survival rates were significantly differences among the treatments.

The production (gross and net production) of fry of *O. pabda* obtained at the end of the experiment and summarized in Table 5. From the Table 5, the initial weight at stocking (kg/ha) different significantly ($p < 0.05$) among the treatments, while the total production (kg/ pond) at harvesting under different treatments were significantly differed ($p < 0.05$). The mean gross and net production of the fry after 4 weeks of nursing period recorded 4187.78±41.58 and 4186.58±41.58, 4496.34±32.72 and 4494.84±32.72 and 3552.30±5.60 and 3550.50±5.6 kg/ha in T1, T2 and T3, respectively, indicating that as growth and percentage of survival decreased with increase in stocking density, the total production of fish did not maintain the same trends (Table 5).

**Table 1:** Proximate composition of the supplementary feeds supplied in experimental ponds

| Brand Name of feed | Type of feeds | Crude protein | Crude lipid | Crude fiber | Ash | Carbohydrate | Moisture |
|---|---|---|---|---|---|---|---|
| **Quality Fish** | Pre-nursery | 43.15 | 8.10 | 3.00 | 10.00 | 21.95 | 10.80 |
| **Feed** | Nursery | 39.35 | 9.55 | 3.00 | 10.90 | 24.20 | 11.00 |

Calcium and Phosphorous were used in both types of feeds which were not calculated.

**Table 2:** Water quality parameters of weekly samples under the three treatments during 4-week nursing period

| **Parameter** | **Treatments** | | |
|---|---|---|---|
| | **T1** | **T2** | **T3** |
| **Water temperature (°C)** | $29.98 \pm 1.55^{a}$ | $30.88 \pm 1.34^{a}$ | $30.89 \pm 1.22^{a}$ |
| **Dissolved oxygen (mg/l)** | $6.01 \pm 0.89^{a}$ | $5.11 \pm 0.57^{b}$ | $4.23 \pm 0.74^{c}$ |
| **pH** | $7.24 \pm 0.91^{a}$ | $7.59 \pm 0.32^{a}$ | $7.93 \pm 0.81^{a}$ |
| **Transparency (cm)** | $31.16 \pm 3.25^{c}$ | $39.68 \pm 2.22^{b}$ | $47.54 \pm 5.31^{a}$ |
| **Total alkalinity (mg/l)** | $141.26 \pm 10.25^{a}$ | $136.29 \pm 11.57^{bc}$ | $134.55 \pm 12.87^{c}$ |
| **Total Ammonia-nitrogen (mg/l)** | $0.04 \pm 0.02^{c}$ | $0.06 \pm 0.03^{b}$ | $0.09 \pm 0.02^{a}$ |

Mean± SD (Standard deviation) and range in parentheses; Figures in the same column having different superscript are differed significantly ($P > 0.05$).

**Table3**. Plankton abundance (cells/l) of pond water of weekly samples over the 4-week experiment

| **Plankton Group** | T1 | T2 | T3 |
|---|---|---|---|
| **Phytoplankton** | | | |
| Bacillariophyceae | $3339 \pm 409^{a}$ | $2801 \pm 321^{b}$ | $2441 \pm 202^{c}$ |
| Chlorophyceae | $4421 \pm 302^{a}$ | $3325 \pm 323^{b}$ | $2254 \pm 447^{c}$ |
| Cyanophyceae | $2651 \pm 329^{a}$ | $2158 \pm 325^{b}$ | $1758 \pm 256^{c}$ |
| Euglenophyceae | $1652 \pm 224^{a}$ | $1425 \pm 198^{b}$ | $1105 \pm 352^{c}$ |
| **Total** | $12063 \pm 316^{a}$ | $9709 \pm 292^{b}$ | $7558 \pm 314^{c}$ |

| | | | |
|---|---|---|---|
| **Zooplankton** | | | |
| Crustacea | 2354 ± 305[a] | 1988 ± 26[b] | 1666 ± 199[c] |
| Rotifera | 3586 ± 298[a] | 3152 ± 409[b] | 2598 ± 42[c] |
| **Total** | 5940 ± 306[a] | 5140 ± 335[b] | 4264 ± 310[c] |

Figures in the same row having the same superscript are not significantly different ($p > 0.05$). Mean± SD (Standard deviation)

**Table 4:** Growth performance and percentage of survival of *O. pabda* fry after 4 weeks of nursing under different stocking densities

| Treatments | Initial length (cm) | Initial weight (g) | Final length (cm) | Final weight (g) | Survival rate (%) |
|---|---|---|---|---|---|
| T1 | 1.13±0.02[a] (1.00-1.30) | 0.0006±0[a] (0.0005-0.0008) | 3.35±0.39[a] (3.12-3.48) | 3.71±0.42[a] (3.59-3.78) | 57.57±2.06[a] (55.51-59.62) |
| T2 | 1.13±0.02[a] (1.00-1.30) | 0.0006±0[a] (0.0005-0.0008) | 3.01±0.31[b] (2.88-3.14) | 3.54±0.13[b] (3.51-3.57) | 51.43±0.81[ab] (50.62-52.24) |
| T3 | 1.13±0.02[a] (1.00-1.30) | 0.0006±0[a] (0.0005-0.0008) | 2.47±0.19[c] (2.29-2.65) | 2.66±0.36[c] (2.57-2.68) | 45.68±0.89[b] (44.79-46.56) |

Mean values in the column with different superscripts are significantly different ($p < 0.05$)

**Table 5:** The gross and net productions of *O. pabda* fry at different stocking densities after 4 weeks of nursing

| Treatments | Initial stocking wt. (kg/ha) | Total production (kg/pond) | Production (kg/ha) | |
|---|---|---|---|---|
| | | | Gross | Net |
| T1 | 1.2[c] | 67.82±0.68[b] (67.14-68.49) | 4187.78±41.58[b] (4146.20-4229.35) | 4186.58±41.58[b] (4145.00-4228.15) |
| T2 | 1.5[b] | 72.82±0.53[a] (72.29-73.34) | 4496.34±32.72[a] (4463.62-4529.05) | 4494.84±32.72[a] (4462.12-4527.55) |
| T3 | 1.8[a] | 57.53±0.09[c] (57.44-57.62) | 3552.30±5.60[b] (3546.70-3557.90) | 3550.50±5.6[c] (3544.90-3556.10) |

Mean values in the column with different superscripts are significantly different ($p < 0.05$)

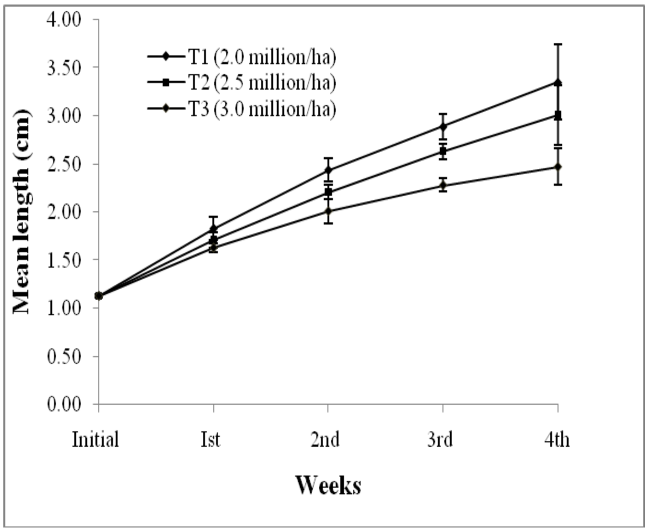


Fig. 1: Weekly length (cm) gain of *O. pabda* under different stocking densities (mean ± SE)

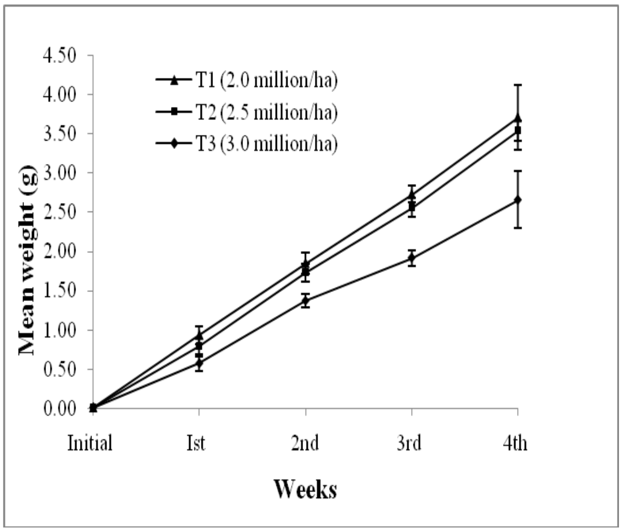


Fig. 2: Weekly weight (g) gain of *O. pabda* under different stocking densities (mean ± SE)

## DISCUSSION

Water quality parameters are the most important factors to maintain the healthy aquatic environment and production of food organisms in cultural ponds. However, growth, feed efficiency and feed consumption of fish are normally governed by a few environmental factors (Kohinoor *et al.*, 2012; Rahman *et al.*, 2017). The ranges of water temperature were recorded 28.40 to 31.90 ºC from the experimental ponds are within the suitable range for rearing of pabda fry and agree well with the findings of Haylor and Mollah (1998), Wahab *et al.*, (1995), Mollah and Hossain (1998) and Rahman *et al.*, (2005, 2008 and 2017). Comparatively higher water transparency was recorded in T3 than those in T2 and T1, might be due to the reduction of the plankton population by higher density of fish (Rahman, 1992; Haque *et al.*, 1994; Rahman *et al.*, 2008, 2017; Ali *et al.*, 2018). Comparatively lower dissolved oxygen level was recorded in ponds stocked with a high density of fish compared to ponds where stocking density was low, might be due to the higher consumption rate of oxygen by the higher density of fish and other aquatic organisms (Boyd, 1982). Similar trends of dissolved oxygen concentrations were also reported by Rahman and Rahman (2003) and Rahman *et al.* (2008, 2017) in various carp, shing and barb nursery ponds. In the present study, the dissolved oxygen level was within the acceptable range for fish culture (Mollah and Hossain, 1998; Rahman *et al.*, 2005, 2008, 2017 and Ali *et al.*, 2018). The mean pH value of the present study agrees well with the findings of Mollah and Hossain (1998), Rahman and Rahman (2003) and Rahman *et al.*, (2005, 2008 and 2017) and are within the range of good water quality for nursing of fish fry/ fingerlings in earthen ponds. Normally the natural waters contain 40 mg/l or more total alkalinity which considered as hard water for biological purposes. Generally hard waters are the most productive for fish culture than soft water. The observed alkalinity levels in the present study indicate productivity of the ponds was medium to high (Jhingran, 1991; Rahman *et al.*, 2005, 2008 and 2017). The average level of ammonia-nitrogen recorded from the experimental ponds is lower than that was reported by Dewan *et al.*, (1991) and Rahman *et al.*, (2008 and 2017). Kohinoor *et al.*, (2001) found the ammonia-nitrogen ranged from 0.1 to 1.55 mg/l in monoculture ponds. However, the present level of ammonia-nitrogen in the experimental ponds is not lethal to the fishes (Kohinoor *et al.* 1998, and 2001; Rahman *et al.*, 2008, and 2017).

The plankton abundance in the experimental ponds was significantly higher in $T_1$ might be due to the lower density of fish than those in $T_2$ and $T_3$. It seems likely that in the ponds where stocking density was high, consumption of plankton by the fishes was also high. Normally, higher plankton density in pond water indicates higher productivity of the pond which is suitable for fish culture. The phytoplankton abundance was consistently higher than that of zooplankton. The highly abundance of phytoplankton population might be due applied cowdung in ponds and excess uneaten feeds (Keshavanath *et al.*, 2002; Islam, 2002) and decreased grazing pressure on phytoplankton due to bottom dwelling and omnivorous nature of pabda (Bhuiyan and Islam, 1991; Taleb *et al.*, 1991; Rahman *et al.* 2008). However, the plankton abundance in the present study showed to be more or less similar with the findings of Rahman *et al.* (2008) and Monir and Rahman (2015).

Growth in terms of final length and weight and survival rate of *O. pabda* in nursery ponds showed that the significantly higher ($p$ < 0.05) performance occurred in T1 where the stocking density of fry was 2.0 million/ha compared to those of T2 (2.5 million fry/ha) and T3 (3.0 million/ha. The lower growth performances occurred in T3 than those of T1 and T2.The reasons behind this might include competition for food and space due to higher density of fish. The results of the present experiment coincide with the findings of Islam (2002), Rahman and Rahman (2003), Rahman *et al.* (2005, 2008, 2017). High density of larvae in combination with food abundant in the rearing system might produce a stressful condition if not from the build-up of metabolites than from competitive interaction (Houde 1975; Haque *et al.*, 1994; Rahman *et al.*, 2005). In the present study, survival rate of fry was significantly higher ($p$ < 0.05) in T1, where the stocking density was 2.0 million/ha. So, the lowest stocking density showed the higher survival in T1 compared to those in T2 and T3. The lower survival recorded T1 and T2 for higher stocking density of fry as they competed for food and space in the experimental ponds. Similar results also were obtained by Mollah and Hossain (1998), Rahman and Rahman (2003) and Rahman *et al.*, (2008 and 2017) from their fry/fingerlings rearing experiments with various carp, barb and catfish species.

The highest gross and net production were obtained in T2 where fry stocked with 2.5 million/ha, which were significantly differed ($p$ < 0.05) from production obtained in T1 and T3 where fry stocked with 2.0 million/ha and 3.0 million/ha, respectively. Survival and growth of fry were inversely related to the stocking densities but it didn’t maintain same trends in case of production. The medium stocking densities of 2.5 million/ha showed the highest production, while the lowest production was obtained in ponds stocked with 3.0 million/ha (Table 5). During the study period, the water quality parameters of pond water were within the optimum ranges for fry nursing, the growth of fry to a greater extent was depended on the quality and quantity of food available. Plankton availability varied among the ponds during the study period due to different densities and highest plankton availability showed in stocked with lower stocking density. The supplied feed amount in different ponds was based on the number of fry stocked and the amount provided was kept at the same level. However, lower growth observed in where at higher stocking densities could be due to less availability of natural food (plankton), competition and some changes in environmental parameters (Kohinoor *et al.*, 1997). The findings of the present study are more closely supported with those reported by Kohinoor *et al.*, (1994), Rahman and Rahman, (2003) and Rahman *et al.*, (2004, 2008 and 2017).

## CONCLUSION

Finally it can be concluded that the growth, survival and production of pabda fingerlings were inversely related to the stocking densities of fry. In consideration production, the stocking density of 2.5 million fry/ha showed better results than both the higher (3.0 million fry/ha and lower (2.0 million fry/ha) stocking rates. So, the stocking density of 2.0 million fries/ha suggested for nursing of *O. pabda* fry in primary nursing

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