J. Agrofor. Environ. 3 (1): 163-166, 2009 ISSN 1995-6983

Effects of bamboo trimmings on the growth and production of Indian major carp, *Labeo rohita* (Hamilton, 1822)

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Abstract: An experiment was carried out with bamboo trimmings (T_1) and without bamboo trimmings (T_2) for a period of 168 days starting from 08 August, 2007 to 25 January, 2008 to observe the eefect of bamboo trimming on the growth and production of *Labeo rohita* (Hamilton, 1822). Eight ponds were used for the study with average pond size was 12.67 dec., and all the ponds were stocked with fingerling of *Labeo rohita* at the rate of 40 dec^{-1}. Numbers of bamboo trimmings were 480 dec^{-1}. Ponds were fertilized regularly, however, no supplementary feed were applied. The physico-chemical parameters of water quality were more or less within the suitable range in both the treatments except water temperature which decreased abnormally during December and January. The addition of bamboo trimmings increased weight gain and production of *Labeo rohita* 2.54 and 2.49 times, respectively. The mean survival rate was 79.37±2.41 and 80.21±3.83 in T_1 and T_2. It is concluded that bamboo trimmings are necessary to promote growth of periphyton grazing fish.

Key words: Bamboo trimming, *Labeo rohita*, growth and production

Introduction

Bangladesh is one of the most populous countries in the world. Poverty, malnutrition, ill health and illiteracy are the common rural phenomenon. Despite increased food production, the country continues to suffer from lack of food security. The people of the country have long been suffering from malnutrition, especially animal protein malnutrition. Per capita per day intake of protein is 37 g against the standard requirement of 49 g and fish is the core source of animal protein, which contributes 63% of the total animal protein (DoF, 2003). The Government of Bangladesh, various international agencies and the NGOs have long been working to alleviate poverty in different ways. Fisheries sector is till far from gaining full momentum in the mainstream farming systems. It is the time to take decision to grow more fish for the mass people of the country. The increased production may be attributed providing a substrate for the growth of periphyton to facilitate fish grazing for higher production. In a trial at Bangladesh Agricultural University field complex obtained 1.89 and 1.09 MT ha-1 of Indian major carp (*Labeo rohita*) production over four months with and without bamboo poles, respectively (Mannan, 1996). However, a comprehensive study on the effects of bamboo trimmings on the growth and production of rohu and its economic profitability is necessary. Since theft is a big problem of fish culture in the rural area. Therefore, putting bamboo trimmings into ponds to deter theft is a traditional farmer practice in Bangladesh. However, the research was conducted to determine the profitability of using bamboo trimmings as periphyton substrate.

Materials and Methods

Study site, period and design: The study was conducted in eight farmer's pond under Bogra sadar upazila of Bogra district for a period of 168 days during 08 August, 2007 to 25 January, 2008. The experiment was carried out with two treatments such as T_1 (with bamboo trimmings) and T_2 (without bamboo trimmings). A total of eight ponds have been selected with an average size of 12.67 dec areas.

Pond preparation: The ponds were poisoned at a rate of 50 g dec.$^{-1}$ ft.$^{-1}$ water depth. Six days after poisoning the ponds were limed at a rate 250 kg ha^{-1}. Five days later basal doses of fresh cow manure, T.S.P and urea were applied at rates of 2500, 50 and 25 kg h^{-1}, respectively. Following basal fertilization, bamboo trimmings of 175 cm lengths were 'planted vertically 35 cm into the pond bottom mud with 140 cm of bamboo in the water column, at a density of 480 dec^{-1} in four ponds under T_1. The side slopes of treatment ponds were not planted with bamboo and were kept a bamboo free border of approximately 100 cm widths.

Stocking: The fingerlings of *Labeo rohita* were purchased from a local nursery. Then the ponds were stocked with of 40 fingerlings dec^{-1}. The mean weights were 22.81±2.92 and 22.93±3.21 g in T_1 and T_2, respectively.

Pond Management: The ponds were monitored regularly, and cow manure, urea and T.S.P were applied at the rate of 357, 25 and 12.5 kg ha^{-1} respectively at 10 days interval. Since removal of enough bamboo trimmings were tough and disruptive to the trial pond's environment and fish, therefore, no sampling was conducted during the culture period. Only the ponds were observed closely for 5 minutes twice daily (morning and afternoon) for seeing of fish activity.

Water quality monitoring: The water quality parameters were measured fortnightly within 00.90-12.00 hours except periphyton determination. Surface water temperature was recorded. Dissolved oxygen, pH and total alkalinity were measured in the four corners of each pond by Hach aquaculture test kit (FF-2). Water transparency was measured with Secchi disc in the corners of each pond throughout the study period.

Harvesting and growth estimation of fish: The ponds were drained and harvested the fish after 168 days of stocking. The bulk weight of fish was taken and the average weight were measured with the help of a portable sensitive balance (HL 400 EXPERIMENT) graduated in a 0.01 g and recorded. Growth gained by the fishes was determined by subtracting the previous weight recorded at the time of stocking. The following parameters were used to evaluate the growth –

a) weight gained= mean final weight- mean initial weight

b) SGR (% bd^{-1}) = $\dfrac{\mathrm{Log_e} W_2 - \mathrm{Log_e} W_1}{T_2 - T_1}$ × 100 (after Brown, 1957)

Where,

W_1 =the initial live body weight (g) at time T_1 (day), and
W_2 = the final live body weight (g) at time T_2 (day)

Estimation of survival rate and yield of fish: The survival rates of fishes for each treatment were estimated on the basis on number of fish harvested at the end of the experiment. Then the gross yield of fish in each treatment was determined by multiplying the average gain in weight of fish and by the total numbers of fish survival in each treatment at the end of the experiment.

Statistical analysis: Data obtained from the experiment were analyzed to determine the effects of different inputs and management practices applied in both the treatment. An independent *t*-test was performed to know difference regarding water quality parameters, growth and production of fish between the treatments. All statistical analyses were performed using Statistical Package for Social Sciences (windows version 11.5) and MS Excel.

Results and Discussion

Water quality parameters: Analysis of the various physico-chemical factors of pond water generated a large number of data. The mean values of water quality parameters of the treatments are presented in Table 1. Early morning water temperature varied between a maximum of 32.5°C in August and dropped steadily thereafter to a minimum of 16.0°C in January. Water temperatures were less than 20°C from mid December to the end of the experiment in late January. The present findings agreed with the findings of Kohinoor (2000), Haque (2000) and Ferdosh (2003). Secchi disc readings were within 18-49 cm, except for one exceptional reading of 10 cm. The transparency range (18-49 cm) as recorded in the present study was similar with the findings of Kohinoor (2000), Raihan (2001) and Ferdosh (2003). As dissolved oxygen is an important factor, therefore, for getting high yield of fish production, the adequate amount of dissolved oxygen should be maintained through scientific management. Dissolved oxygen ranged between 4.0-13.4 mg l^{-1} in the present study. Wahab *et al.* (1995) recorded dissolved oxygen ranging from 3.4 to 7.79 mg l^{-1} which more or less satisfies the present findings. pH fluctuated between 6.3 to 8.7. The pH values of all the experimental ponds were about neutral, which indicates good productivity of the pond. The present findings agreed with the findings of Kohinoor (2000) who recorded pH values of 6.5 to 8.0, Raihan (2001) found pH ranges from 6.8 to 9.24 and Uddin (2002) recorded pH values of 6.14 to 8.88 in the ponds in the BAU campus. Natural waters which contain 40 mg l^{-1} or more alkalinity are considered for biological purposes as hard waters. Alikunhi (1975) total alkalinity more than 100 ppm should be present in highly productive water bodies. The mean values of total alkalinity (Table 1) agree the findings of Kohinoor (2000) and Uddin (2002). It is concluded that with the exception of the declining water temperature later in the trial, all of the measured water quality parameters were within acceptable ranged and were unlikely to have limited fish growth.

Table 1. Mean values (±SD) with ranges of water quality parameters of the experimental ponds under two treatments during the study period

Parameters	T1	T2	Remarks
Temperature (°C)	31.38±1.55 (16.0-31.9)	31.44±1.29 (17.3-32.5)	NS
Transparency (cm)	28.2±1.08 (18-49)	24.66±3.37 (18-43)	NS
Dissolved oxygen (mg l-1)	7.12±0.22 (4.0-3.5)	6.03±0.32 (4.4-13.4)	NS
pH	7.41±0.35 (6.3-8.47)	7.54±0.05 (6.5-8.6)	NS
Total alkalinity (mg l-1)	115.93±5.88 (107-125)	123.6±15.12 (102-154)	NS

Figures in parenthesis indicates minimum and maximum values; NS indicates not statistically significant

Fish growth and survival rate: Fish survival and growth rates with and without bamboo substrate are given in Table 2. Mean final weight and final weight was significantly (P<0.05) higher in T_1 (bamboo used). However, other indices were insignificant. Individual daily fish weight gain ranged between 0.28 – 0.42 g day^{-1}, with a mean weight gain of 0.34 g day^{-1} for the control ponds. For the treatment ponds with bamboo trimmings, individual daily fish weight gain ranged between 0.51-1.06 g day^{-1}, with a mean weight gain of 0.88 g day^{-1}. The weight gain of fish in T_1 is more or less similar to the mean daily weight gain of 0.90 g day^{--1} in NFEP demonstration farmers ponds for *Labeo rohita* cultured in polyculture in small seasonal ponds (NFEP, 1994). Survival rate of rohu were more than 70% in both the treatment is acceptable, however, do not differed significantly.

Table 2: Various growth indices and survival rate of rohu in different treatment during study

Parameters	**T_1**	**T_2**	**Remarks**
Mean initial weight (g)	22.81±2.92	22.93±3.21	NS
Men final weight (g)	198.29±13.28	92.85±18.11	**
Mean weight gain (g)	177.48±4.87	69.92±3.41	**
SGR (% bd^{-1})	1.22	2.00	NS
Survival (%)	80.21±3.83	79.37±2.41	NS

The fish production: The final production of rohu was 0.71 and 1.77 MT ha^{-1} in T1 and T_2 (Fig.1). The production was significantly (P<0.05) higher in T_1 which indicates the substrate increases fish production. Mannan (1996) reported *Labeo rohita* production rates in a shorter four month trial at BAU, Mymensingh campus of 1.89 and 1.09 MT ha^{-1} in ponds with (9 m^{-2}) and without bamboo poles, respectively. The production was slightly higher due higher density. Therefore, it supports the present findings.

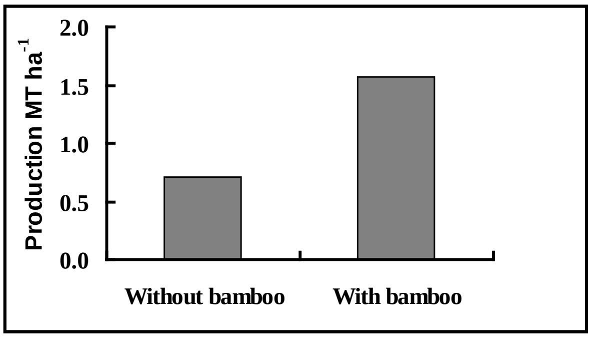

Fig. 1: Final production in the treatments during the study

Economics: Details of total cost and income from the experiments are presented in Table 3. Total running costs for the control ponds were Tk. 23,498.31 ha^{-1}, with the rotenone being the major cost (43.9%). When calculating the running costs for the bamboo treatment it was assumed that the bamboo can be used for two years and includes transportation costs for the bamboo and labour Costs to plant it. Total running costs for the bamboo treatment were Tk. 46,523.28 ha^{-1} with the purchase, transport and planting of the bamboo trimmings being nearly 50% of the total and rotenone 22%. As per NFEP project recommendations for their demonstration farmers for polyculture in seasonal ponds was between Tk. 25,000-30,000 ha^{-1}. The running cost was 1.77 times higher in T_1 (with bamboo trimmings); however, return was 14.35 times higher. Therefore, culture of Indian major carp, rohu is profitable and hereby recommended for using bamboo in the ponds as substrate.

Table 3: Costs and income of the study

Item	Price (Tk. kg^{-1})	T_1 (with bamboo) Total Cost (Tk)	T_2 (without bamboo) Total Cost (Tk.)
Rotenone	250	506.44 (22.20%)	566.46 (43.90%)
Lime	5.5	66.69 (2.92%)	74.66 (5.80%)
Cow manure	0.5	60.63 (2.66%)	67.88 (5.30%)
Urea	5.0	12.13 (0.53%)	13.58 (l.l0 %)
TSP	8.0	9.70 (0.43%)	10.86 (0.80%)
Fish	0.3 each	145.50 (6.38%)	162.90 (12.63%)
Bamboo	-	1, 127.50 (49.5%)	-
Routine Cow manure	0.5	155.92 (6.84%)	174.56 (13.50%)
Routine urea	5.0	109.13 (4.78%)	122.18 (9.40%)
Routine TSP	8,0	87.30 (3.83%)	97.74 (7.57%)
Total cost	-	2,280.94 (100%)	1,290.74 (100%)
Cost ha^{-1}	-	46,523.28	23,498.31
Fish price	-	50.00 kg^{-1}	35.00 kg^{-1}
Income	-	Tk. 3,856.74	Tk.1,400.64
Profit margin (%)	-	169.09	108.51
Profit ha^{-1}	-	32,140.86	1,999.31

Figures in the parenthesis indicate % values of total cost

Monoculture of *Labeo rohita* stocked at 1 m^{-2} in regularly fertilized ponds without feeding, with and without bamboo trimmings as a substrate for periphyton resulted in financial benefit during 168 days trial. The addition of bamboo trimmings resulted significantly ($P<0.05$) higher growth performance of rohu and also the final production. Individual weight gain and production increased 2.54 and 2.49 folds, respectively for the bamboo trimmings treatment against the control without bamboo. The addition *of* bamboo trimmings traditionally practiced by farmers to deter theft provides a substrate for periphyton growth which promotes growth of rohu. Despite the increased financial returns of tile trial, the dramatic result on *Labeo rohita* production by the addition of bamboo trimmings merits encourages us for further study.

Acknowledgement: The authors thank to BADP, Bogra, World Vision Bangladesh for their support during the study.

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