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Effects of rice bran on growth and survival of Thai sharpunti *Barbodes gonionotus* in earthen ponds

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Abstract

An experiment was carried out with *Barbodes gonionotus* for 4 months (120 days) in the experimental ponds of size of 2.8 decimal each with the same stocking densities of 57 fish/dec. in all the treatments. Each pond was divided into two equal halves by synthetic net fixed with bamboo. Three treatments (T_1, T_2 and T_3) each with two replicates were used. The fish were reared in only fertilized pond (T_1), in fertilized and rice bran fed pond (T_2) and only rice bran fed pond (T_3). During the study period the water quality parameters such as temperature, transparency, water depth, dissolved oxygen, pH and plankton biomass in all treatments were within productive range. The observed growth parameters such as mean weight gain were 36.24 g, 65.85 g and 44.41 g, percent weight gain were 120.80%, 219.52% and 148.03%, the average daily gain were 1.28 g, 2.37 g and 1.64 g, the specific growth rate were 0.66%, 0.97% and 0.77%, in $T_{1,}$ T_2 and T_3 respectively. The gross total productions of Sharpunti were 844.64, 1292.85 and 930.36 kg/ha/120 days. The net productions were 462.49, 888.39 and 555.35 kg/ha/120 days in $T_{1,}$ T_2 and T_3 respectively. The gross and net total productions in T_2 were highest compared to T_1 and T_3. Sharpunti showed highest growth performance in T_2 when fine rice bran was used as feed and simultaneously the pond was fertilized.

Keywords: Rice bran, Growth, Survival, Thai sharpunti

Introduction

Fish production in a water body is largely dependent upon the basic fertility of the water body and the supply of supplementary feeds. The intensive fish culture depends to a large extent on supplementary feeding (Balarin and Haller, 1982).

The production of fish in our country is very low compared to other countries of the world due to lack of technical knowledge and proper management practices. Bangladesh is facing today the problem of protein caloric malnutrition. This protein deficiency is becoming more and more acute because of the tremendous population growth without any significant increase in animal production. To meet up this acute animal protein shortage of the country the present production level has to be increased to manifolds. This can be achieved by bringing all the water bodies under improved fish culture and management practices (Monju, 1996).

All the vital functions of fish like feeding, digestion, assimilation, growth, responses to stimuli and reproduction are dependent on water quality. Limnological works have been carried out in different areas of the world to have some knowledge about the water quality and its limiting and optimum range of aquatic organisms. For improved fish culture it is also imperative to know how feeds are related to growth and survival for profit maximization. Therefore, the present experiment was designed to ascertain the effects of rice bran on growth and survival of Thai Sharpunti *Barbodes gonionotus* in the traditional small earthen ponds.

Materials and Methods

Study area: The experiment was conducted from 1st January to 30th April 2006 (120 days) to observe the effect of different feed ingredients on the production performance of Thai Sharpunti, *Barbodes gonionotus*

To study the growth rate, survival rate and production potential of *B. gonionotus,* three treatments were used in the experiment, each pond (2.8 decimal) with two replications was divided into two by fencing right at the middle by the help of synthetic durable nets and bamboos. The six segments of 3 ponds were used for this experiment feeding with supplementary feed like fine mesh rice bran. Stocking density remained same in all treatments viz. 57 fish/dec. (Table 1).

Table 1. Experimental design

Treatment	Pond	Replication	Feed ingredients	Stocking density (fish/decimal)
T_1	1	2	Fertilizer	57
T_2	2	2	Fertilizer + Rice bran	57
T_3	3	2	Rice bran	57

In treatment- 1 under fertilized (inorganic and organic) condition
In treatment- 2 feeding with rice bran under fertilized condition
In treatment- 3 feeding with only rice bran

Pond preparation: All the ponds were dried by draining out the water with a dewatering pump. Lime was applied at a rate of 1kg per decimal. Lime was liquefied into an earthen pot then applied by spreading homogeneously on the pond bottom. After one week ponds were filled with water and urea and TSP were applied at the rate of 200g and 100g per decimal respectively.

Stocking: The ponds were stocked with same densities. Eighty fish were released in each pond segment (1.4 decimal in size). The ponds were stocked randomly with the fish of average size 30±0.05 g. The length and weight of fish were recorded before releasing them. Feeding began just after stocking.

Feed supply: Feed was provided at the rate of 5% of the total biomass. In T_1 ponds were fed with only fertilizer (200 g Urea + 100 g TSP and 1 kg cow dung per segment/7 days) during the experimental period. Ponds under T_2 and T_3 were fed with fertilizers and rice bran and only rice bran respectively at the same rate. Fortnightly growth was monitored in each pond to adjust the feeding rate. The fish were fed twice daily at 08h and 17h.

Sampling procedure: Sampling was done every fifteen days interval. Stocked 10% sharpunti were sampled from each of the pond in the morning (from 08h to 09h) by using seine net. The length of the body of each fish sample were measured in centimeters (cm) while weight of the fish were measured in nearest gram (g) by using measuring scale and electronic balance (Metler PM 480) respectively.

Water quality parameters: The water quality parameters such as water depth, transparency, temperature, dissolved oxygen (DO) and pH were monitored fortnightly throughout the experimental period. Water temperature of the ponds was measured with the help of Celsius thermometer. Dissolved oxygen of the pond water was measured by using an oxygen meter (Oxymeter WTW, Multi 340i). Electronic pH meter (Jenway, model 3020, UK) was used to measure the pH of water. Water transparency and depth were measured by using secchidisc and weighted measuring tape respectively. All analysis was done in the Water Quality and Pond Dynamics Laboratory of the Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh.

Plankton biomass

Collection, preservation and enumeration of plankton: Plankton samples were collected fortnightly from experimental ponds. Ten litre samples of pond water were collected from different areas and depth of the pond and filtered through a fine meshed (25 mm) phytoplankton net. Filtered sample was taken into a measuring cylinder and carefully made up to standard volume with distilled water. Using plastic tubing, water was siphoned off from the measuring cylinder and plankton were concentrated into 50 ml and preserved using 5% buffered formalin in small plastic vials for subsequent studies. From each 10 ml preserved sample, 1 ml subsample was examined using Sedgwick-Rafter cell (S-R cell) and binocular microscope (Olympus BH2).

Counting: The S-R counting cell is a special type of slide having a counting chamber which is 50 mm long, 20 mm wide and 1 mm deep; the volume of the chamber is 1 ml. The counting chamber is equally divided into 100 fields, each having a volume of 0.01 ml.

Calculation: Calculation of plankton samples were done by using the following formula (Rahman, 1992).

$$N = \frac{A \times 100 \times C}{V \times F \times L}$$

Where,

N = No. of plankton cells or units per litre or original water
A = Total no. of plankton counted
C = Volume of final concentrate of the sample in ml.
V = Volume of a field = 1mm^3
F = No. of fields counted
L = Volume of original water in litre

Harvesting of Thai Sharpunti: After 4 months of rearing, the fishes were harvested on 120 days. After harvesting by seine net all fishes were counted and weighed individually for each pond to assess the survival rate and production.

Analytical methods: The proximate composition of feed ingredient was analyzed in triplicate according to standard procedures given by Association of Official Analytical Chemists (AOAC, 1980).

$$\text{Moisture (\%)} = \frac{\text{Original sample weight} - \text{dried sample weight}}{\text{Original sample weight}} \times 100$$

Crude protein = 6.25 $\times$ % Nitrogen

$$\%\text{Nitrogen} = \frac{\text{Milliequivalent of nitrogen (0.014)} \times \text{titrant value (ml)} \times \text{strength of HCl}}{\text{Sample weight (g)}} \times 100$$

$$\text{Crude lipit (\%)} = \frac{\text{Weight of lipid (g)}}{\text{Weight of sample (g)}} \times 100$$

$$\text{Ash content (\%)} = \frac{\text{Weight of ash (g)}}{\text{Weight of sample (g)}} \times 100$$

$$\text{Crude fibre (\%)} = \frac{\text{Weight of sample after air drying (g) - weight of sample after ashing (g)}}{\text{Weight of sample (g)}} \times 100$$

Nitrogen free extract (NFE) = 100 - % (moisture + protein + lipid + ash + crude fibre)

Analysis of the experimental data

Experimental data collected during the growth trial in different treatment were evaluated by using the following parameters.

Growth parameters

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

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

$$\text{c) SGR (\%/day)} = \frac{\text{Log}W_2 - \text{Log}W_1}{\text{Time}} \times 100$$

Where,

W_1 = Initial live body weight (g) at time T_1 (day)
W_2 = Final live body weight (g) at time T_2 (day)

d) Average daily gain (g)

$$\text{ADG} = \frac{\text{Mean final fish weigh} - \text{Mean initial fish weight}}{T_2 - T_1}$$

e) Cumulative weight gain (g)

CWG = Mean final fish weight

Statistical analysis: Duncan's new multiple range test (DMRT) and one-way analysis of variance (ANOVA) were used to determine the effect of different feeds on the growth of fish to identify the 1% level of significance of variance among the treatment means. Standard deviations (±SD) of treatment means were also calculated.

Results and Discussion

Water quality parameters

In the present study, water quality parameters were found to range within good and normal aquaculture condition. The water quality parameters remained more or less similar. Not very large discrimination was seen among them (Table 2; Figs. 1a to 1e).

Table 2. Comparisons of water quality parameters (mean ± SD) among three treatments by using ANOVA

Parameters	Treatment- 1	Treatment- 2	Treatment- 3	F- value	Level of significance
Temperature (^{0}C)	29.73 ± 0.14	29.75 ± 0.86	29.74 ± 0.50	0.106	NS
Transparency (cm)	37.99 ± 1.91	30.88 ± 1.80	36.06 ± 0.74	10.91	NS
Water depth (cm)	151.94 ± 2.07	144.86 ± 0.39	150.64 ± 2.54	7.85	NS
DO (mg/L)	4.41 ± 0.67	4.63 ± 0.44	4.51 ± 0.14	2.82	NS
pH	7.25 ± 0.58	7.41 ± 0.57	7.28 ± 0.03	7.69	NS
Plankton biomass	50.80 ± 3.68^a	56.15 ± 2.38^b	52.98 ± 5.27^b	62.26	**

Plankton biomass = no. x 10^5 cell/l
NS indicates non significant at 1% level.
Figures in the same row with same letters are not significantly different (P>0.01)

Temperature (^{0}C): The mean values of water temperature were 29.73 ± 0.14, 29.75 ± 0.86 and 29.74 ± 0.50 ^{0}C in T_1, T_2 and T_3 respectively (Table 2, Fig.1a). Dewan (1973) recorded temperature range of 19.0-35.0 ^{0}C from a pond situated at Mymensingh.

Transparency (cm): Transparency recorded in this experiment were 37.99 ± 1.91, 30.88 ± 1.80 and 36.06 ± 0.74 cm in the T_1, T_2 and T_3 respectively. The highest and lowest transparency of water bodies were 45.52 cm and 24.23 cm in the month of January and March in T_1 and T_2 (Table 2, Fig.1b). Keilhorn (1952) reported that transparency of water was affected by microscopic organisms, suspended organic matter and heavy plankton growth.

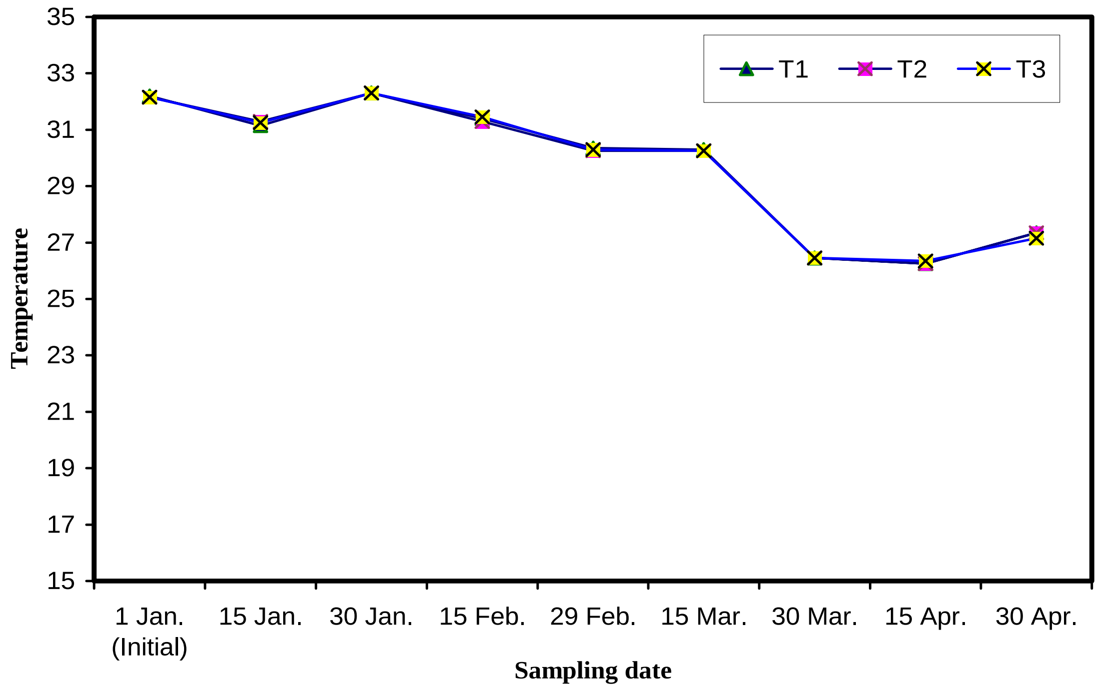

Fig. 1a. Showing the variations of temperature (^{O}C) under three treatments

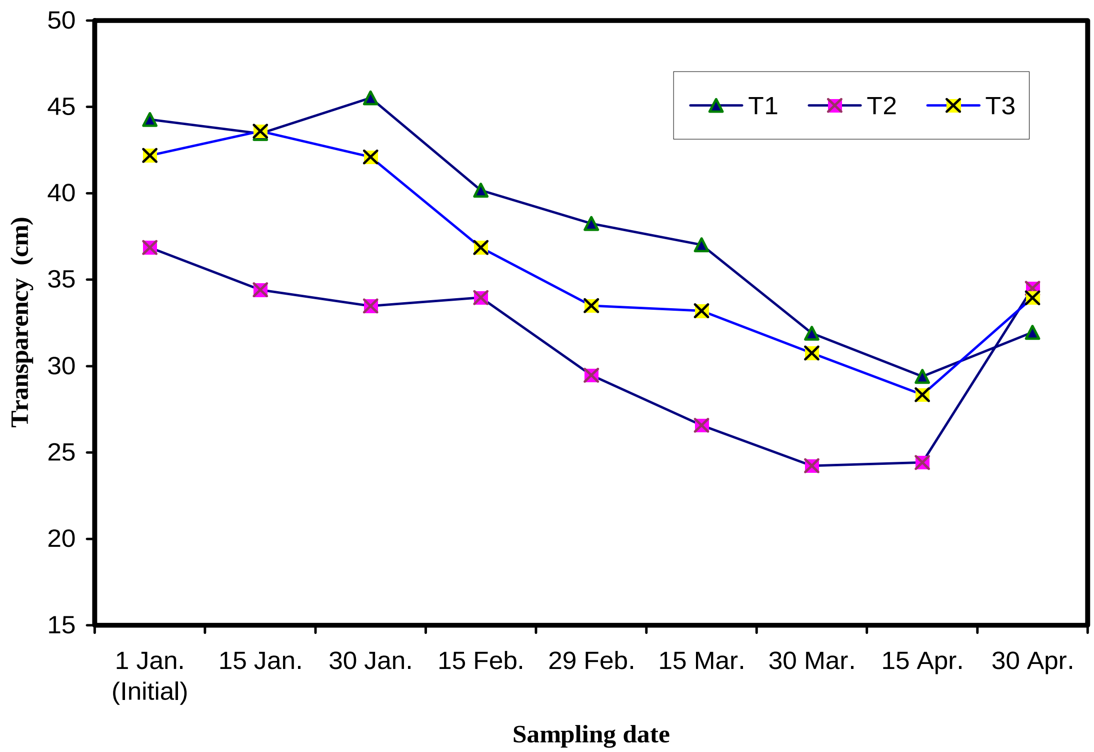

Fig. 1b. Showing the variations of transparency (cm) under three treatments

Water depth (cm): Water depth were 151.94 ± 2.07, 144.86 ± 0.39 and 150.64 ± 2.54 cm in the T_1, T_2 and T_3 respectively. The highest and lowest water depths were 155.38 and 134.98 cm during the month of April in the T_3 and T_2 respectively (Table 2, Fig.1c). There was no significant change of water level during the experiment.

Dissolved oxygen (mg/l): Dissolved oxygen were 4.41 ± 0.67, 4.63 ± 0.44 and 4.51 ± 0.14 mg/l in T_1, T_2 and T_3 respectively (Table 2, Fig.1d). Alikunhi (1957) stated that good pond water for fish cultivation should have a fair amount of dissolved oxygen ranging from 5 to 7 ppm. Benerjea (1967) considered 5.0 to 7.0 mg/L dissolved oxygen content of water to be fair or good in respect of productivity. Sreenivasan (1976) reported that high rate of decomposition of organic matter decreases the oxygen content in the bottom. Ali *et al.* (1982) observed DO values of 7.2-10.5 mg/L throughout the period of investigation in freshwater pond. On the other hand, Rahman *et al.* (1982) measured DO values of 0.40-8.8 mg/L. The result showed an inverse relationship of dissolved oxygen content with temperature. Coche (1967) observed an increase in dissolved oxygen content with the decrease of temperature.

pH: The values of pH were 7.25 ± 0.58, 7.41 ± 0.57 and 7.28 ± 0.03 in T_1, T_2 and T_3 respectively. The highest and lowest pH values were found to be 7.90 and 6.71 in the month of January and April in T_2 and T_1 respectively (Table-2, Fig.1e).

Plankton biomass

Plankton biomass in the present study was more or less similar in T_1 and T_3 but comparatively higher in T_2. It may be due to the excreta of sharpunti, fertilization and effect of uneaten rice bran. Plankton biomass was 50.80 ± 3.68, 56.15 ± 2.38 and 52.98 ± 5.27 in the T_1, T_2 and T_3 respectively (Table-2, Fig.1f). The highest and lowest plankton number was recorded to be 58.50 x 10^5 /l and 50.65 x 10^5 /l during the months of February and April in the T_2 and T_3 respectively. The colour of pond water was more or less greenish for couple of months but it became turbid because of vigorous movement of growing fishes and searching of foods which might cause low values of oxygen. It might be caused due to reduction of photosynthetic activities by plant during the days of less sunlight. Islam *et al.* (1996) recorded maximum phytoplankton in June-July and October which also agreed with the findings of present study.

Growth parameters

Fortnightly growth parameters of Thai Sharpunti *B. gonionotus* under three treatments using the different feeds like fertilizers and rice bran were studied during the experimental period. The growth parameters such as initial weight (g), cumulative weight gain (g), weight gain (g), percentage weight gain (%), specific growth rate or SGR (% per day) were recorded and shown in Table 3.

Table 3. The mean values (± SD) of growth parameters among the three treatments during experimental period by using ANOVA

Species	Growth parameters	Mean (+ SD) values			F value	Level of significance
		T_1	T_2	T_3		
Thai Sharpunti (*Barbodes gonionotus*)	Weight gain (g)	36.24 ± 0.96^a	65.85 ± 1.42^b	44.41 ± 2.93^c	121.904	**
	Percent weight gain (%)	120.80 ± 3.21^a	219.52 ± 4.74^b	148.03 ± 9.76^c	121.904	**
	SGR (% /day)	0.66 ± 0.25^a	0.97 ± 0.37^b	0.77 ± 0.42^a	108.284	**
	ADG (g)	1.28 ± 0.12^a	2.37 ± 0.18^b	1.64 ± 0.44^a	121.904	**
	Cumulative weight gain (g)	66.24 ± 2.93^a	95.85 ± 1.00^b	74.41 ± 2.07^a	121.904	**

** Significant at 1% level of significance
Figures in the same row with same letters are not significantly different (P>0.01)

Weight gain (g): The significantly (P<0.01) highest growth 65.85 ± 1.42 g was observed in T_2 followed by T_3 (44.41 ± 2.93 g) and the lowest growth 36.24 ± 0.96 g was observed in T_1.

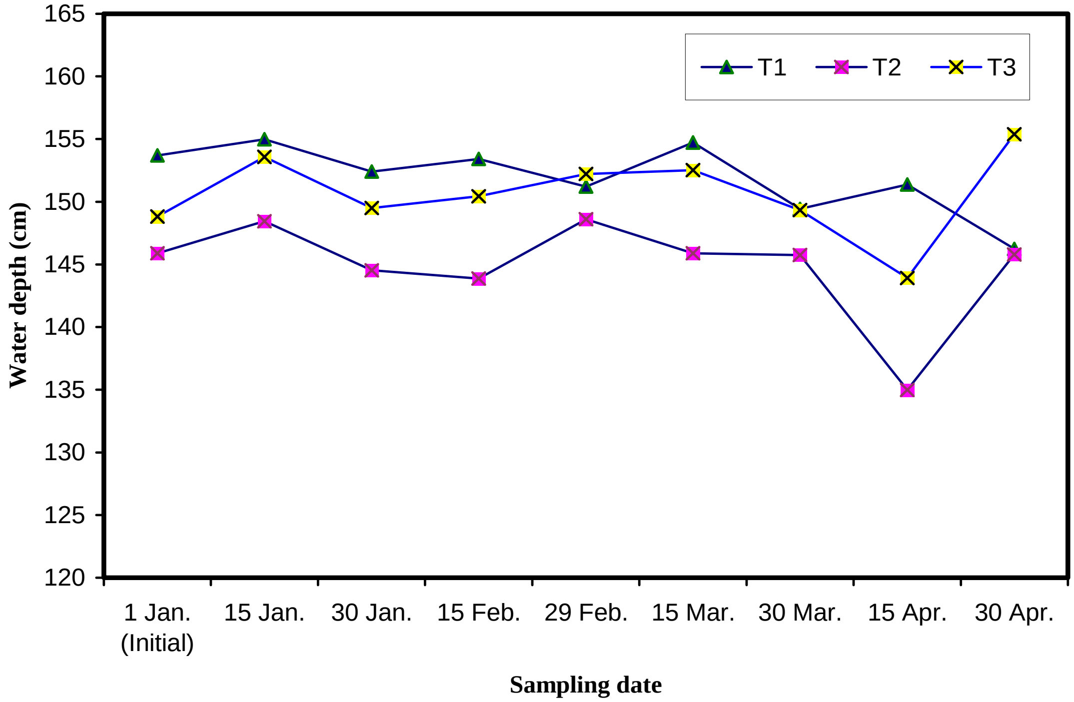

Fig. 1c. Showing the variations of water depth (cm) under three treatments

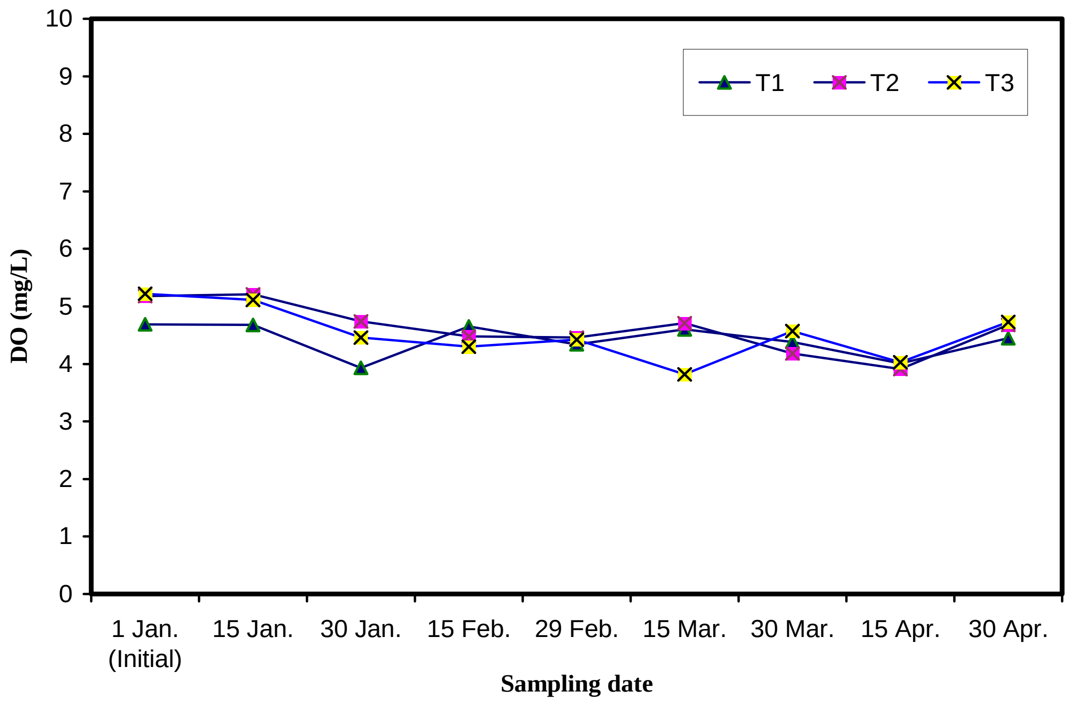

Fig. 1d. Showing the variations of dissolved oxygen (mg/L) under three treatments

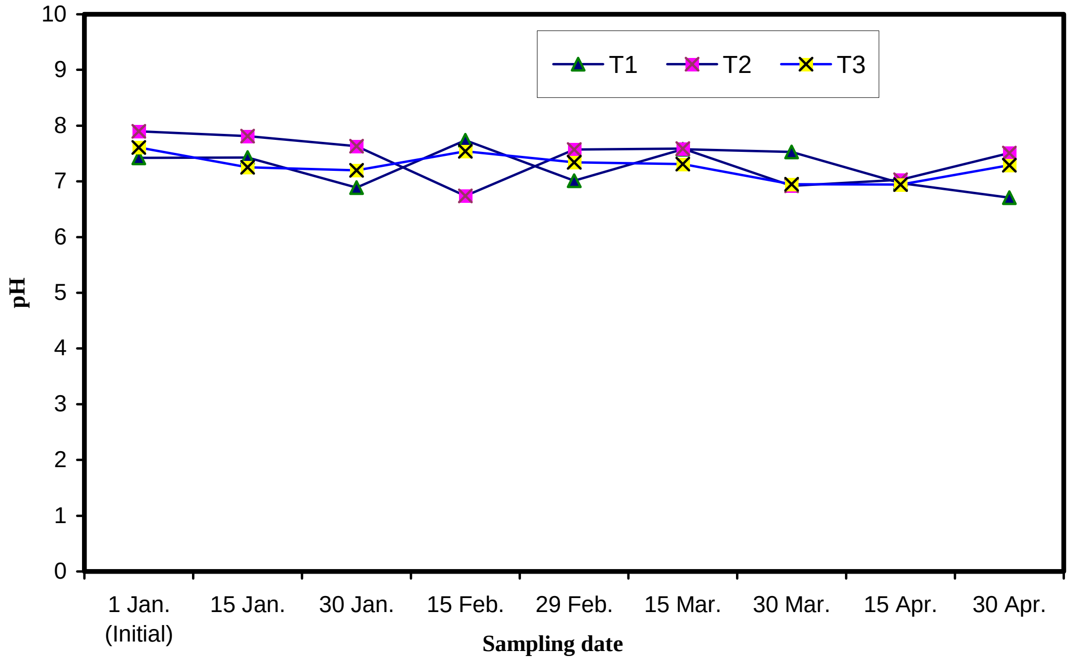

Fig. 1e. Showing the variations of pH under three treatments

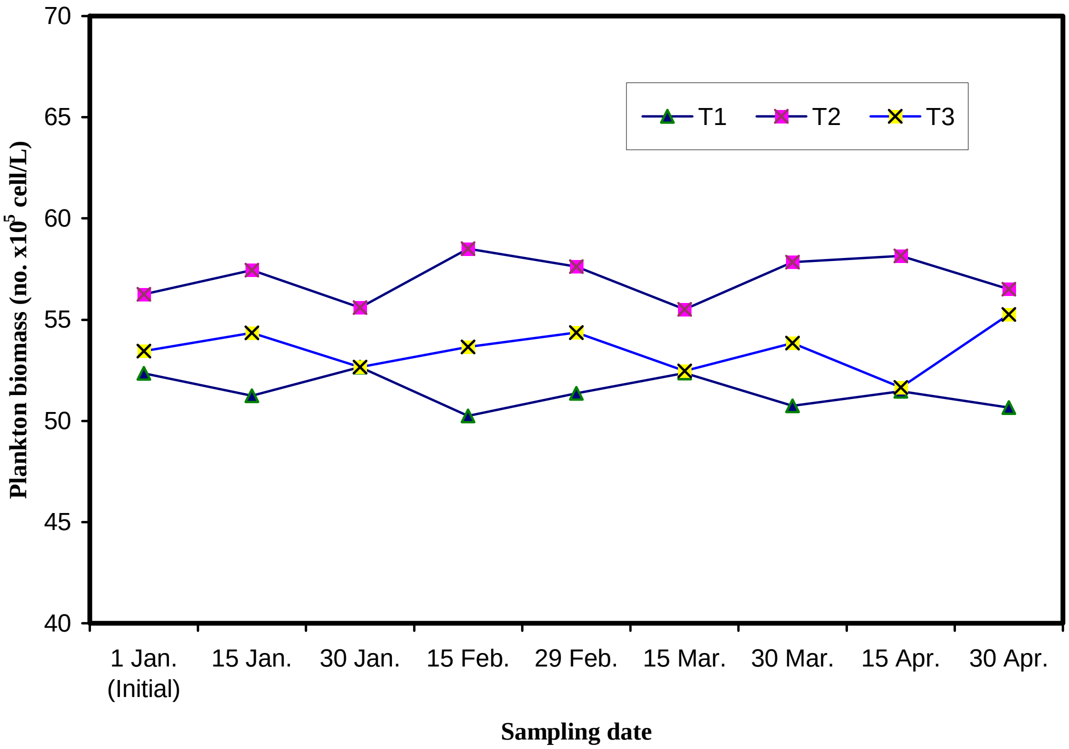

Fig. 1f. Showing the variations of plankton biomass (no. x10^5 cell/L) under three treatments

Percentage weight gain (%): The percent weight gain (%) of *Barbodes gonionotus* in different treatments ranged from 120.80 ± 3.21 to 219.52 ± 4.74. The lowest percent weight gain was observed to be 120.80 ± 3.21 in T_1 while the significantly (P<0.01) highest percent weight gain of 219.52 ± 4.74 was observed in T_2 followed by T_3 (148.03 ± 9.76).

Specific growth rate or SGR (% per day): The specific growth rate of *B. gonionotus* in different treatments ranged from 0.66 ± 0.25 to 0.97 ± 0.37. The lowest specific growth rate of 0.66 ± 0.25 was observed in T_1 while the significantly (P<0.01) highest specific growth rate of 0.97 ± 0.37 was observed in T_2 followed by T_3 (0.77 ± 0.42).

Average daily gain (g): The average daily gain (g) of *B. gonionotus in* different treatments ranged from 1.28 ± 0.12 to 2.37 ± 0.18 g. The lowest average daily gain was 1.28 ± 0.12 g observed in T_1 while the significantly (P<0.01) highest average daily gain was 2.37 ± 0.18 g observed in T_2 followed by T_3 (1.64 ± 0.44 g).

Cumulative weight gain (g): The cumulative weight gain of *B. gonionotus* in different treatments ranged from 66.24 ± 2.93 to 95.85 ± 1.00 g. The lowest cumulative weight gain was 66.24 ± 2.07 g observed in T_1 while the significantly (P<0.01) highest cumulative weight gain was 95.85 ± 1.00 g observed in T_2 followed by T_3 (74.41 ± 2.07 g).

Growth performance of Thai Sharpunti

In the present study, the higher weight gain and percentage weight gain were observed in the fish of T_2 when compared with other treatments. This observation clearly indicated that Sharpunti grows rapidly when reared in the ponds regularly fertilized and rice bran is used as feed. In such situation fish gets higher plankton population in a fertilized pond and supplied rice bran and feed on. They were found to respond to fine rice bran very quickly and feed on it voraciously. Similar results were also recorded by Hepher (1971), Singh and Singh (1975) and Hussain *et al.* (1987).

Survival rate

The survival rates of *B. gonionotus* during the period of experiment were 89.37%, 94.37% and 87.50% in $T_{1,}$ T_2 and T_3 respectively. In the present study the highest survival rate was found in T_2 (Table 5).

Proximate composition of experimental diet

The proximate composition of fine rice bran used in the experiment has been analyzed and the results are shown in Table 4. Dry matter content was 88.14%, protein content was 9.53%, lipid content was 9.81%, ash content was 13.59%, crude fibre content was 4.76% and nitrogen free extract (NFE) was 50.45%.

Table 4. Analyzed proximate composition of rice bran used in *Barbodes gonionotus* monoculture (% dry matter basis) for whole experimental period

Components	Percentage (%)
Dry matter	88.14
Protein	9.53
Lipid	9.81
Ash	13.59
Crude fibre	4.76
NFE[1]	50.45

[1.] Nitrogen free extract calculated as 100% (moisture + crude protein + ash + crude fibre)

Total production

Net production of Sharpunti was 462.49, 888.39, 555.35 kg/ha/120 days in T_1, T_2 and T_3 respectively (Table 5 and Fig. 2). The net production of T_2 was significantly higher than those of T_1 and T_3. Kohinoor *et al.* (1993) obtained *B. gonionotus* production of 23.84 kg/ha/6 months for fertilized pond along with supplemental feeding and 2,129.72 kg/ha/6months with only supplementary feed as rice bran. Hussain *et al.* (1989) obtained *B. gonionotus* production of 1,952 kg/ha/5 months with only supplemental feed as rice bran and 689 kg/ha/5 months with only fertilizers.

Table 5. Initial weight (g), stocking density, production (kg/ha) and survival rate (%) of Thai Sharpunti in three treatments during the whole experiment

Treatments	Replication No.	At stocking		At harvesting					Survival rate (%)		Total production (kg/ha/120 days)			
		No. of fish released	Initial weight (g)	Final weight (g)	Net increase	No. of fish recovered	Total weight (g)		Treatments	Average	Gross		Net	
							Gross	Net			Treatments	Average	Treatments	Average
T_1 (57 fish/dec.)	1	80	30	65.56	35.56	73	4.78	2.60	91.25	89.37	853.57	844.64	464.28	462.49
	2	80	30	66.92	36.92	70	4.68	2.58	87.50		835.71		460.71	
T_2 (57 fish/dec.)	1	80	30	96.86	66.86	77	7.46	5.15	96.25	94.37	1332.14	1292.85	919.64	888.39
	2	80	30	94.85	64.85	74	7.02	4.80	92.50		1253.57		857.14	
T_3 (57 fish/dec.)	1	80	30	76.48	46.48	69	5.28	3.21	86.25	87.50	942.86	930.36	573.21	555.35
	2	80	30	72.34	42.34	71	5.14	3.01	88.75		917.86		537.50	

In the present study, the result showed that *B. gonionotus* when cultured in combination with rice bran (fine) and fertilizer gave best growth performance in terms of weight gain 65.85 ± 1.42 g in a culture period of 4 months.

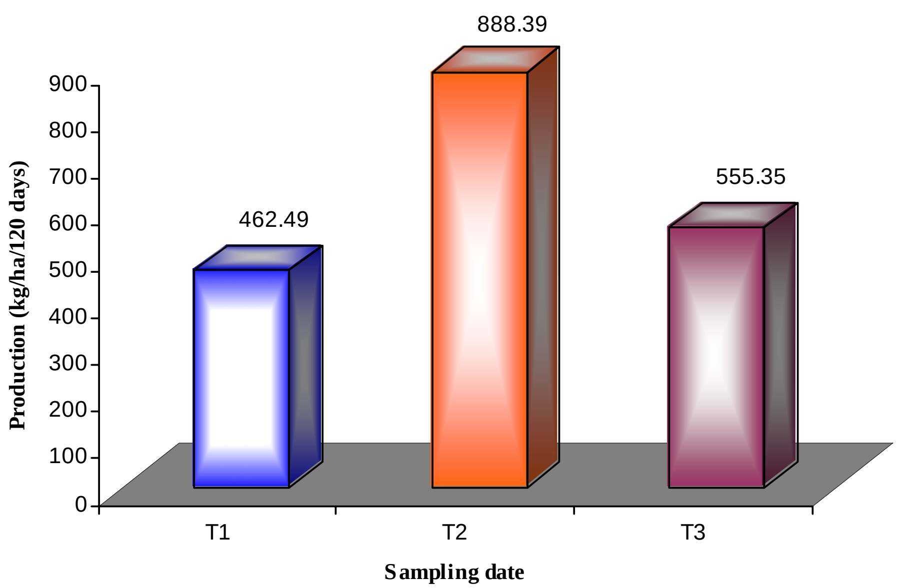

Fig. 2. Showing the net production (kg/ha/120 days) of *Barbodes gonionotus*

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