FISH FERTILIZATION. 5. EFFECT OF ARTIFICIAL FEED ON THE GROWTH PERFORMANCE OF MAJOR CARPS

Muhammad Javed, Muhammad Hassan & Khalid Javed
Fisheries Research Farms,
Department of Zoology and Fisheries,
University of Agriculture, Faisalabad

The response of artificial feed (30% crude protein) in major carps rearing pond has been studied. The results indicated the use of artificial feed in two ways: (i) direct utilization of feed, and (ii) indirect response of left over feed in terms of planktonic productivity. The planktonic biomass accounted for about 42% of the variations in fish yield. Correlation coefficients between increase in fish yield and planktonic productivity in both treated and control ponds were significant. Added nitrogen, in the form of crude protein, resulted in significant increase in wet weight, fork length, and total length of fish. However, increase in fish yield showed linear relationship with concomitant increase in water temperature. The maximum benefit from artificial feed was derived by *Cirrhina mrigala* followed by *Labeo rohita* and *Catla catla*.

INTRODUCTION

Fish is an important source of high quality proteins (Javed, 1988). Due to low dressing percentage of other meat animals, the importance of fish as a substitute has further increased in the country. To reduce pressure on consumption of mutton and beef as well as poultry meat and to provide fish food at cheaper rate to common man, the maximum development of fish resources is essential.

The utilization of dietary protein in fish is largely dependent on the nutrient efficiency, acceptability of diet (Mohanty *et al.*, 1990) and the cultural conditions (Javed, 1988). Information on protein utilization and its influence on fish growth, particularly of major carps, in relation to different protein and fat levels in the diet is scarce, though their optimum requirements are known (Sen *et al.*, 1978; Singh and Bhanot, 1988; Mohanty *et al.*, 1990). The present investigation was taken up to determine the efficiency of fish in terms of growth performance under the influence of supplementary diet at 30% crude protein level.

MATERIALS AND METHODS

The methods adopted for experimentation were the same as given by Javed *et al.* (1989) with the exception that artificial feed with 30% crude protein (Table 1) was added to the treated pond at the rate of 0.10 g N (from 100/4.80 x 0.10 = g artificial feed) per 100 g of wet fish weight daily for one year. However, the control pond received no additives.

RESULTS

a. Growth performance of fish: The initial average weights of *Catla catla, Labeo rohita* and *Cirrhina mrigala* in treated and control ponds were 2.68 ± 0.06, 2.46 ± 0.03 and 2.25 ± 0.04 g, respectively with fork lengths of 55.30 ± 0.07, 55.00 ± 0.05 and 59.03 ± 0.07

mm, respectively. The initial average total lengths of stocked *Catla catla, Labeo rohita* and *Cirrhina mrigala* in both treated and control ponds were 65.29 ± 0.04, 65.02 ± 0.09 and 69.11 ± 0.08 mm, respectively.

Table 1. Composition of fish feed

Ingredients	Percentage
Cottonseed meal (Decorticated)	40
Bone meal	10
Blood meal	10
Meat meal	10
Fish meal	15
Wheat bran	12
Vitamin and mineral mix	1
Limestone	2
Crude protein	30

The response of treatment towards increase in weight, fork length and total length was highly significant. The growth performance of three fish species showed statistical differences at 0.01% level of significance. *Cirrhina mrigala* attained maximum weights in both treated and control ponds, being 773.01 and 216.96 g, respectively. However, *Catla catla* responded poorly in both treated and control ponds with the final average weights of 471.71 and 128.29 g, respectively and the differences were highly significant. *Labeo rohita* attained average final weights of 529.14 and 140.85 g in treated and control ponds, respectively. The interaction (treatment x species) for gaining weights was significant due to the performance of *Catla catla* and *Labeo rohita* which exhibited non-significant differences for their weight gains in control pond (Table 2).

In treated pond *Cirrhina mrigala* gained better fork lengths (with an average final fork length of 363.99 mm) as compared with other two fish species. However, the differences among three fish species were statistically significant. In control pond, all the three fish species exhibited almost the same trend in their fork length increments as *Cirrhina mrigala* attained an average fork length of 243.73 mm which differed significantly from that of other two fish species (Table 2). The effect of treatment for gaining fish total length was highly significant. In both treated and control ponds, *Cirrhina mrigala* gained maximum average total lengths which differed significantly from that of *Labeo rohita* and *Catla catla.* However, the differences between *Catla catla* and *Labeo rohita* in control pond were not significant. It is clear from the above findings that the fish species under study showed different trends in gaining weights, fork lengths and total lengths with some exceptions as in control pond *Catla catla* and *Labeo rohita* performed similarly for their weight and total length increments. Each of the three fish species performed according to its inherent potential as far as their length-weight relationships were concerned.

b. Feed and planktonic biomass conversion ratios: A total of 391.26 kg of feed which contained 18.78 kg nitrogen was added to get 137.84 kg of fish treated pond during the period of one year. Thus, the nitrogen incorporation efficiency of fish was 13.62%. However, the feed conversion ratio remained at 2.84 i.e. 2.84 kg of feed was added in treated pond to get one kg of fish flesh. The pond productivity, as measured in terms of standing dry weight of planktonic biomass, of 56.10 g per m^3 (Table 3) of water gave an increase of 7.98 g fish in treated pond. However, in control pond an average planktonic productivity of 10.52 g per m^3 gave an increment of 2.29 g fish yield. The planktonic biomass conversion ratios in treated and control ponds remained at 31 and 26%, respectively.

Table 2. Analysis of variance on increase in fish weights, fork and total lengths

Source of variance	Df	Mean squares		
		Weight	Fork length	Total length
Treatment	1	5804157.53**	338998.56**	481152.55**
Species	2	453882.08**	71471.93**	70934.93**
Treatment x Species	2	131890.99**	2439.27**	3497.19**
Error	138	466.71	69.55	83.18
Total (n-1)	143			

** = Significant at 1% level.

Comparison of means

Fish species	Weight (g)		Fork length (mm)		Total length (mm)	
	Treated	Control	Treated	Control	Treated	Control
Catla catla	471.71 c ± 4.52	128.29 e ± 3.34	270.87 c ± 2.03	180.63 f ± 2.03	330.37 c ± 1.35	224.08 e ± 1.63
Labeo rohita	529.14 b ± 5.24	140.85 e ± 3.60	292.16 b ± 1.37	191.45 e ± 2.20	342.88 b ± 1.53	221.05 e ± 2.83
Cirrhina mrigala	773.01 a ± 6.43	216.96 d ± 4.24	363.99 a ± 2.41	243.73 d ± 1.60	421.99 a ± 2.83	279.33 d ± 1.42

Values with a similar letter in a column are statistically similar at 5% level of significance.

Table 3. Treatment values for increase in fish yield, planktonic biomass conversion efficiency and net yields of fish. Treatment means with the same letters in a single column are statistically similar at 5% level of significance

	Feed added (kg)	Total nitrogen (kg)	Increase in fish yield (kg)	Planktonic productivity (g/m^3)	Planktonic conversion efficiency (%)	Net fish yield (kg ha^{-1} $year^{-1}$)
Treated	391.26	18.78	137.84 a	56.10 a	31.00 a	2871.67 a
Control	Nil	Nil	36.83 b	10.52 b	26.00 b	767.29 b

The differences between treatments for their response towards planktonic biomass production, increase in fish yield and planktonic biomass conversion ratios were statistically significant (Table 3). The correlation coefficients between increase in fish yield and planktonic productivity, in both treated and control ponds, were highly significant (Table 4). Regression equation of increase in fish yield on planktonic productivity in treated and control ponds were also computed (Table 4). The equation under treated pond revealed about 42% of the variations in fish yield were due to planktonic productivity and coefficient of determination (R^2) was significant ($R^2 = 0.423$). The correlation coefficients between increase in fish yield vs total nitrogen added and water temperature were statistically highly significant.

c. Fish yield: At the end of one year experimental period, both the ponds were harvested for final fish catch. The net yield of *Catla catla, Labeo rohita* and *Cirrhina mrigala,* together, in treated and control ponds were 137.84 and 36.83 kg, respectively. However, the net fish yield ha^{-1} $year^{-1}$ (all fish species) from treated and control ponds were computed as 2871.67 and 767.29 kg, respectively (Table 3).

Table 4. Correlation coefficients among different parameters under study

	r	R^2
Total nitrogen added vs increase in fish yield	0.633**	
Water temperature vs increase in fish yield	0.987**	
Regression equations		
Treated pond:		
Increase in fish yield = 4.28 + 0.067 (Planktonic biomass)	0.651**	0.423*
Control pond:		
Increase in fish yield = 1.04 + 0.119 (Planktonic biomass)	0.552**	0.305^{NS}
Critical value (1-tail, 0.05) = + or - 0.334		

DISCUSSION

Increase in fish yield showed almost linear trend with concomitant increase in water temperature as correlation coefficient between increase in fish yield and water temperature was positive and highly significant (0.987) (Table 4). Soderberg (1990) reported highly significant and positive correlation (r = 0.99) between temperature and growth rate of blue *Tilapia* in intensive aquaculture. The response of treatment (feed) towards planktonic biomass production and increase in fish yield was significant and the correlation coefficient between them was positively significant (Tables 3, 4). The R^2 value, for the regression equation, under treated pond reveals 42% of the variations in fish yield due to planktonic productivity. The findings of Javed *et al.* (1990) that within each temperature range the availability of planktonic food increased the growth rate of carps, were in line with the observations recorded during the present study. The remaining variations in fish yield (i.e. 58%) may be due to direct utilization of artificial feed as the correlation coefficient between added nitrogen and increase in fish yield was highly significant (Table 4). This indicates two ways of responding to artificial feed (i) direct feeding, and (ii) indirect utilization (Huq, 1957; Javed, 1984) through the fertilization of pond by the left over feed, resulting in the planktonic production. Table 4 also predicts increase in fish yield due to increased quantities of planktonic biomass. The low value of "r" for the equation also reveals other factors responsible for the increase in fish yield, for example direct utilization of feed. This means that nitrogen added in the form of crude protein was completely utilized either through direct feeding of fish or indirectly when left over feed was decomposed at the pond bottom, released nutrients which contributed towards increase in planktonic productivity. Boyd (1973) and Javed (1984) reported increased planktonic biomass due to the application of artificial feed in fish ponds.

The maximum weight was gained by *Cirrhina mrigala* in treated pond. This weight increment was significantly more than *Labeo rohita* and *Catla catla* (Table 2) indicating this species responded the best to the artificial feed. The findings of Chakarbarty *et al.* (1976) contradicted the results of the present study as they observed comparatively better performance of *Catla catla* in culture system relying mainly on the supply of artificial feed. In the present study, the benefit derived by *Catla catla*, from the artificial feed, was less than that of *Labeo rohita* and *Cirrhina mrigala* but the presence of proteolytic enzymes in *Catla catla* (Ranade and Kewalramani, 1967) suggested physiological capability of utilizing high protein diet like groundnut oil cake. However, Yasmin (1987) reported better performance of *Cirrhina mrigala* than *Labeo rohita* and *Catla catla* in artificial feed supplemented pond as reported from the present investigation.

The net fish yield under treated and control ponds remained at 2871.67 and 767.29 kg ha^{-1} $year^{-1}$, respectively (Table 3). However, the feed conversion ratio was computed as 2.84 i.e. 2.84 kg of feed worth Rs. 17.04 was required to get one kg of fish flesh worth Rs. 40.00 in the market. Sheri *et al.* (1987) reported the gross fish yield of major carps under artificial feed (29.21% crude protein) and inorganic fertilization (single super phosphate) as 2153.75 kg ha^{-1} per 9 months.

REFERENCES

Boyd, C.E. 1973. Summar algal communities and primary productivity in fish ponds. Hydrobiolgia, 41: 357-390.

Chakarbarty, R.D., P.R. Sen, N.G.S. Rao and S.R. Ghosh. 1976. Intensive culture of Indian major carps. FAO Tech. Conf. Aquaculture. Advances in Aquaculture. Fishing News Books Ltd., Farnham, Surrey, England.

Huq, N. 1957. Feeding of Fish. Proc. East Pak. Fishery Office Conf., Dhaka.

Javed, M. 1984. Effect of artificial feed on the growth of *Labeo rohita.* M.Sc. Thesis, Dept. Zoology and Fisheries, Univ. of Agri., Faisalabad.

Javed, M. 1988. Growth performance and meat quality of major carps as influenced by pond fertilization and feed supplementation. Ph.D. Thesis, Dept. Zoology and Fisheries, Univ. of Agri., Faisalabad.

Javed, M., M.B. Sial, S.A. Zafar, M.W. Salim and N. Parveen. 1989. Fish pond fertilization. 1. Influence of N:P:K (20:20:03) fertilizer on the growth performance of major carps. Pak. J. Agri. Sci. 26 (4): 369-377.

Javed, M., M.B. Sial and S.A. Zafar. 1990. Fish pond fertilization. 2. Influence of broiler manure fertilization on the growth performance of major carps. Pak. J. Agri. Sci. 27 (3): 212-215.

Mohanty, S.N., D.N. Swamy and S.D. Tripathi. 1990. Protein utilization in Indian major carp fry, *Catla catla* (Ham.), *Labeo rohita* (Ham.) and *Cirrhina mrigala* (Ham.) fed four protein diets. J. Aqua. Trop. 5 (2): 173-179.

Ranade, S.S. and H.G. Kewalramani. 1967. Studies on rate of food passage in the intestine of *Labeo rohita* (Ham.), *Cirrhina mrigala* (Ham.) and *Catla catla* (Ham.). FAO Fish Rep. 3 (44): 349-358.

Sen, P.R., N.G.S. Rao, S.R. Ghosh and M. Rout. 1978. Observations on the protein and carbohydrate requirements of carps. Aquaculture, 13: 245-255.

Sheri, A.N., M.B. Sial, M. Javed and F. Sarwat. 1987. Nutrient requirements of the fish. 2. Fertilization with SSP and artificial feed supplementation of pond. Pak. J. Agri. Sci. 24 (1): 24-31.

Singh, B.N. and K.K. Bhanot. 1988. Protein requirements of the fry of *Catla catla* (Ham.). The First Indian Fisheries Forum. Proc. Asian Fisheries Soc., Indian Branch, Mangalore.

Soderberg, R.W. 1990. Temperature effect on the growth of blue *Tilapia* in intensive aquaculture. The Prog. Fish. Cult. 52 (3): 155-157.

Swamy, D.N. and S.M. Mohanty. 1988. Response of Rohu *(Labeo rohita* Ham.) fingerling to diets of different protein contents. In: 3rd Asian Fish Nutr. Workshop held at Bangkok, Thailand, 6-10 June.

Yasmin, S. 1987. Growth performance of *Catla catla* as influenced by feed supplementation of pond. M.Sc. Thesis, Dept. Zoology and Fisheries, Univ. of Agri., Faisalabad.