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NUTRIENT REQUIREMENTS OF THE FISH
i. Pond Fertilization with N. P. K. (20:20:5)

A. N. Sheri, M. B. Sial and M. Javed

Department of Zoology and Fisheries, University of Agriculture, Faisalabad.

The growth performance of major carps viz: *Catla catla, Labeo rohita, Cirrhina mrigala* and common carp, *Cyprinus carpio* has been described. The fishes were kept for a period of 7 months in two katcha ponds, one was fertilized with N. P. K. (20:20:5) and the other served as a control without additives. Analysis of variance was computed. Initial stocking for the control and treated ponds were 7.55 kg and 8.43 kg, respectively. At the termination of the exyeriment the total production per acre/year of control and treated ponds remained 585.74 kg and 1400.09 kg, respectively.

INTRODUCTION

Pakistan, being an agricultural country and maintaining millions of animals on her soil, is under an acute shortage of proteins of high biological value. In fact, one feels there has been a protein famine since long and this situation has caused a serious reduction in the mental and physical performance of most vulnerable group of human population. Federal and Provincial Governments in the country have given frequently quite a few incentives to the promising animal breeders including those running poultry operations but the situation on availability of animal proteins i.e. from milk, meat and eggs has not yet eased out with respect to both consumption of required amounts as well as its price to suit a middle or lower middle class man. There is, therefore, an urgent need for increasing tremendously such valuable nutrients if the country is going to share equally well in the national endeavours to compete with international intellectual and physical efforts for development. Fish culture in an intensive form seems to be the only feasible preposition, that is economical, easy and rapid for execution and making such nutrient available in short period of time. It can yield much more/acre/year than other animals without involving much of capital and technical knowledge. Fertilization of fish ponds as stated by Hepher (1963) is

the best means of increasing fiish production particularly, those of carps. Fertilization, besides increasing fish production, gives better intensification of hygenic production by increasing the quantity of natural food for fish. Many workers have recorded higher fish yields through pond fertilization (Boyd, 1976, Boyd and Sowles, 1978, Dimitrov, 1974 and Vlasov 1972).

Thus an experiment, as a part of the project, "Nutrient Requirements of the Fish" was conducted to establish the effect of pond fertilization on the growth of carps, viz: *Catla catla*, *Labeo rohita*. *Cyprinus carpio*, and *Cirrhina mrigala* in a polyculture system. This system of culture, as recommended by Stanley *et al.* (1978) was adopted to get maximum utilization of food available in the ponds by fishes of different feeding habits. The study involved (1) measurement of growth in terms of (a) body weights, (b) fork lengths and (c) total body length as influenced by input/fertilization, and total production of the ponds.

MATERIALS AND METHODS

Two kacha ponds of dimensions 25m x 8m x 1.5m were selected for the experiment at the Government Fish Seed Hatchery, Satiana Road, Faisalabad using one as control and the other as a treated pond. The ponds were dewatered and allowed to dry for 2 weeks (from December 31, 1982 to January 14, 1983). Liming was done with calcium oxide (CaO) at the rate of 10 kg/pond for disinfection and stabilizing the pH of water using the method of Hora and Pillay (1962). On chemical analysis of ponds and tube-well water, the physico-chemical conditions of each pond were found to be similar, inlets of the ponds were screened with fine mesh to avoid the entry of intruders and outlets for escape of fish from ponds. After one week of these preventive measures, the ponds were watered to provide 1.2m depth. Five buckets of water from ponds rich in planktonic life were transferred to each pond so prepared. Both the ponds were stocked, each with 56 fishes on Feb. 4th, 1983 as 12 *Catla catla*, 28 *Labeo rohita*, 8 *Cyprinus carpio* and 8 *Cirrhina mrigala*. The initial mean values of fork length, total length and body weight were recorded, of fishes in each pond before stocking. After placing the fishes, the fertilization of experimental pond with N.P.K (20:20:5) were done at the rate of half kilogram to one kilogram per week to increase the plankton life, as 2 kg/month for the months of March, April and

May while June, July, August and September received 4 kg of N.P.K. (20:20:5). The water samples ware taken from both ponds for testing temperature, colour, pH, and CO_2 concentration in the beginning and after every 30 days till the end of the experiment. During 7 months of experimental period, monthly records on body weight, fork length and total length were maintained by random selection of fishes. Various parameters studied in the experiment were treated statistically by using methods of Steel & Torrie (1960). Output/acre/annum was estimated to see the economic feasibility of application of fertilizer to raise the carps.

RESULTS AND DISCUSSION

The data on growth of 4 species of fish, collected on random sampling basis, included average monthly body weight, fork length and total body length from each pond as influenced by fertilization of ponds. The results are presented in Tables : 1-3, and explained as :

i) *Average body weights :* The initial and final weights of *Catla catla* in control and treated ponds were 42.50, 165.00 gms and 47.08, 422.33 gms, respectively. Idtra pond variation of body weight gain was recorded as 30.00 gms and 98.33 gms to be maximum during the month of July. The same for *Labeo rohita* were found 20.33, 196.26 and 28.50, 474.82 gms in the control and treated ponds, respectively with maximum weight gains in the two ponds during the month of June i.e. 53.46 and 131.42 gms, respectively. As regards the *Cyprinus carpio,* the initial and final body weights in the control pond were 64.50 and 169.52 gms while in the treated pond the values were 63.00 and 389.77 gms, maximum weight gain being attained in this species of fish during the month of August (30.06 & 95.91 for control and treated ponds, respectively). For *Cirrhina mrigala* the initial and final weights recorded during the experiment were 7.50, 163.45 and 11.88, 344.27 gms in the control and treated ponds, respectively, monthly maximum gains in treated pond was during July i.e. 75.66 gms, closely followed by 61.34 and 53.67 gms in June and August, respectively, while control fish showed steady increase through-out the experimental period (Table 1).

ii) *Fork length :* As given in Table 2 the maximum increase in the fork length of *Catla catla* in the control and treated ponds was observed as 17.3mm in August and 35.60 mm during June, respectively. The maximum increase in the fork length of *Lcbeo rohita* was observed during the month of June as 21.20 and 49.40

Table:1 *Increase in body weight (gm) of four fish species in control and treated ponds.*

	Catla catla				*Labeo rohita*				*Cyprinus carpio*				*Cirrhina mrigala*			
	CONTROL		TREATED		CONTROL		TREATED		CONTROL		TREATED		CONTROL		TREATED	
ime erval nonth;	Ave. Wt. gm.	Gain Wt. gm.	Ave. Wt. gm.	Gain Wt. gm.	Ave. Wt. gm.	Gain Wt. gm.	Ave. Wt. gm.	Gain Wt. gm.	Ave. Wt. gm.	Gain Wt. gm.	Ave. Wt. gm.	Gain Wt. gm.	Ave. Wt. gm.	Gain Wt. gm.	Ave. Wt. gm.	Gain Wt. gm.
2-83	42.50	-	47.08	-	20.33	-	28.50	-	64.50	-	63.00	-	7.50	-	11.88	-
3-83	49.16	6.66	65.58	18.50	24.35	4.02	44.28	15.78	68.23	3.73	72.51	9.51	16.66	9.16	25.93	14.05
4-83	65.00	15.84	105.91	40.33	32.22	7.87	62.50	18.22	73.10	5.87	89.81	17.30	34.33	17.67	58.21	32.28
5-83	83.33	18.33	150.00	44.09	44.45	12.23	94.37	31.87	81.45	8.35	111.97	22.16	62.85	28.52	108.60	50.39
6-83	95.83	12.50	185.66	35.66	69.64	25.19	158.12	63.75	94.20	13.75	154.61	42.64	79.78	16.93	153.60	45.00
7-83	119.16	23.33	255.66	70.00	123.10	53.46	289.37	131.25	112.51	18.31	215.47	60.86	89.90	20.12	214.94	61.34
8-83	149.16	30.00	353.99	98.33	162.85	39.75	380.00	90.63	139.46	26.95	293.86	78.39	133.35	33.45	290.60	75.66
9-83	165.00	15.84	422.33	68.34	196.26	33.41	474.82	94.82	169.52	30.06	389.77	95.91	163.45	30.10	344.27	53.67

Table 2: *Increase in fork length (mm) of four fish species in control and treated ponds*

Time Interval in months	*Catla catla*				*Labeo rohita*				*Cyprinus carpio*				*Cirrhina mrigala*			
	CONTROL		TREATED		CONTROL		TREATED		CONTROL		TREATED		CONTROL		TREATED	
	Ave. F.L. mm	Gain F.L. mm	Ave. F.L. mm	Gain F.L. mm	Ave. F.L. mm	Gain F.L. mm	Ave. F.L. mm	Gain F.L. mm	Ave. F.L. mm	Gain F.L. mm	Ave. F.L. mm	Gain F.L. mm	Ave. F.L. mm	Gain F.L. mm	Ave. F.L. mm	Gai F.L mm
4-2-83	141.70	-	143.30	-	120.60	-	127.60	-	155.40	-	151.80	-	105.60	-	120.00	-
6-3-83	143.20	1.50	150.40	7.10	124.50	3.90	144.30	16.70	161.10	5.70	168.50	16.70	125.00	19.40	135.40	15.
5-4-83	150.20	7.00	171.10	20.70	132.30	7.80	162.40	18.10	164.20	3.10	180.10	11.60	151.32	26.32	165.70	30.
5-5-83	165.70	15.50	187.60	16.50	141.10	8.80	175.50	13.10	171.20	7.00	198.70	18.60	165.20	13.88	190.30	24.
4-6-83	174.40	8.70	195.70	8.10	154.70	13.60	195.90	20.40	175.90	4.70	210.20	11.50	178.30	13.10	210.20	19.
4-7-83	185.60	11.20	231.30	35.60	175.90	21.20	245.30	49.40	187.80	11.90	240.10	29.90	195.50	17.20	225.60	15.
3-8-83	190.30	4.70	254.50	23.20	201.80	15.80	277.40	32.10	198.50	10.70	251.40	10.30	220.47	24.97	259.20	33.
2-9-83	207.60	17.30	270.40	15.90	215.10	13.30	301.20	23.80	212.70	14.20	273.50	22.10	230.30	9.83	268.50	9.

mm in the control and treated ponds, respectively. Diminished increment in the increase of fork length was seen in later month in both the ponds. The values of fork length increase in *Cyprinus carpio* were 57.30 mm in the control pond with maximum increase in September (14.20 mm) while 151.80 to 273.50 mm with a maximum increase during June (29.90 mm). The species *Cirrhina mrigala* showed maximnm increase in the month of March (26.32 mm) ranging from 105.60 to 230.30mm in the control pond but during the month of July (33.60mm) ranging from 120 - 268.50 mm in the treated pond. The changes in the fork length appeared to have no significant relation with variation in the body weights of all fishes.

iii) *Total length :* The initial and final total lengths of *Catla catla* in the control and treated ponds were 164.80, 224.80 mm and 168.00, 299.60 mm, respectively, the maximum increase of 16.10 mm was achieved during the month of April followed by 13.70 mm in June in the control pond but of 36.40 mm in June followed by 25.70 mm in March in the treated pond. The *Labeo rohita* showed total length in the control pond from 147.80mm initial to 249.60 mm final values while 148.00 mm initial to 341.70 mm final total length in the treated pond. The maximum increase was observed during June (26.70 mm) in the control while during July (34.80 mm) in the treated pond. In case of *Cyprinus carpio* a range of total length between the initial and final value was observed as 185.30 to 248.50 mm and 181.70 to 304.60 mm in the control and treated ponds, respectively, the maximum increase being attained during the months, June (170.50mm) followed by August (14.20 mm) in the control, while in the treated during the month of May (25.40 mm) followed by June (20.30 mm).

As regards the species *Cirrhina mrigala*, the initial and final total length in the control and experimental ponds were 127.64, 260.68 mm and 132.10, 298.50 mm, respectively. The maximum increase was achieved in the control pond as 33.13 mm in July followed by 29.23 mm in March and 36.61 mm in the month of July followed by 32.20 mm in march in the treated pond. No significant trend in the increase of total length was noticed from both the ponds (Table 3).

iv) *Influence of inputs on fish production :* Average monthly increase/fish in control pond with *Catla catla* was 17.50 gms and in the treated pond it rose to 53.61. The production/acre for Catla catla in control pond was 66.72 kg/7 months and in the treated pond the value rose to 170.79 kg/7 months. Increase

Table 3: *Increase in total length (mm) of four species in control and treated ponds*

	Catla catla				*Labeo rohita*				*Cyprinus carpio*				*Cirrhina mrigala*			
	CONTROL		TREATED		CONTROL		TREATED		CONTROL		TREATED		CONTROL		TREATED	
Time interval in months	Ave. T.L. mm	Gain T.L. mm	Ave. T.L. mm	Gain T.L. mm	Ave. T.L. mm	Gain T.L. mm	Ave. T.L. mm	Gain T.L. mm	Ave. T.L. mm	Gain T.L. mm	Ave. T.L. mm	Gain T.L. mm	Ave. T.L. mm	Gain T.L. mm	Ave. T.L. mm	Gain T.L. mm
4-2-83	164.80	-	168.00	-	147.80	-	148.00	-	185.30	-	181.70	-	127.64	-	132.10	-
6-3-83	170.20	5.40	174.60	6.60	152.50	4.70	165.70	17.70	192.50	7.20	201.50	19.80	141.61	13.97	163.40	31.3
5-4-83	179.30	9.10	200.30	25.70	160.50	8.00	184.20	18.50	196.40	4.90	209.70	8.20	170.84	29.23	195.60	32.2
5-5-83	195.40	16.10	215.40	15.10	172.80	12.30	209.30	25.10	201.10	4.70	220.80	11.10	195.62	24.78	220.10	24.5
4-6-83	199.70	4.30	223.70	8.30	186.40	13.60	243.70	34.40	207.10	6.00	246.20	25.40	208.45	12.83	239.20	19.1
4-7-83	213.40	13.70	260.10	36.40	213.10	26.10	276.70	33.00	224.60	17.50	266.50	20.30	215.61	7.16	252.60	13.4
3-8-83	217.80	4.40	283.50	23.40	234.20	21.10	311.50	34.80	234.40	9.80	285.20	18.70	248.74	33.13	289.21	36.6
2-9-83	224.80	7.00	299.60	16.10	249.60	15.40	341.70	30.20	248.50	14.10	304.60	19.40	260.68	11.94	298.50	9.2

in the weight on the average of *Labeo rohita* in the control pond was 25.13 gms but in the treated pond it was 63.76 gms. The total production/acre/7 months for 28 *Labeo rohita* in the control pond was observed as 185.19 kg in the control pond and 448.04 kg in the treated one. In case of *Cyprinus carpio* the average increase in body weight was 15.28 gms in control and 46.68 gms in the treated pond, The total production/acre/7 months was 45.70 kg and 105.08 kg in the control & treated ponds, respectively. The species *Cirrhina mrigala* showed an average increase in monthly weights of 22.88 gms and 47.48 gms in the control and treated ponds, respectively. The total production figures per 7 months, per acre in the control pond remained at 44.07 kg and in the experimental pond it went up to 92.81 kg. The gross production per year per acre for all the 4 fish species in control and treated ponds was computed to be 585.74 and 1400,09 kg, respectively (Table 4). The fertilization appeared to have exerted a significant influence on the production in terms of weight increase of fishes.

The resuls obtained in the present study go along with those obtained by Smith and Swingle (1943), Swingle (1947), Probst (1950), Hepher (1962), Wood and Sheddan (1971), Boyd and Jehn (1978), Sumitra *et al.* (1981) and Boyd (1981). They too had recorded such an increase in the production of fish due to fertilizer supplementation of ponds. The present study doubtlessly, showed similar results by the application of fertilizer (N.P.K; 20:20:5).

Statistical Analysis :

Analysis of variance was done to work out differences in body weights, fork lengths and total lengths of fish as influenced by fertilization of pond and season or month of the year during 7 months of experiment.

a) *Body weight :* In the control pond the average body weight gains of fish species were statistically non-significantly different, although *Labeo rohita* gained 44.45 gms/month which was apparently higher than other species i.e. *Catla catla* (35.55 gms), *Cyprinus carpio* (30.99 gms) and *Cirrhina mrigala* (34.88 gms). However, in the treated pond, the increase in body weight was 52.88 gms as compared to 20.05 gms in the control pond. The differences were statistically highly significant. The months of July, June and August showed maximum weight gains compared to early months of rearing fish in these ponds. Weight gain remained at the minimum during first month and increased at fairly high rate as the experi-

mental period advanced. The interactions between species v/s month and species v/s treatment were non-significant. The seasonal effect or the treatment effect were similar for all of the four fish species included in the study. The significant interaction between treatment and months (T X M) indicates variable responses of treated as against the control pond during various months (Table 5).

Table 4. *Total production of four fish species per acre per year in control and treated pond.*

Title	Treated				Control			
	Catla catla	*Labeo rohita*	*Cyprinus carpio*	*Cirrhina mrigala*	*Catla catla*	*Labeo rohita*	*Cyprinus carpio*	*Cirrhina mrigala*
Number of fish stocked	12	28	8	8	12	28	8	8
Number of fish recovered	12	28	8	8	12	28	8	8
Survival %	100	100	100	100	100	100	100	100
Initial average weight(gms)	47.08	28.50	63.00	11.88	42.50	20.33	64.50	7.5
Final average weight(gms)	422.33	474.82	389.77	344.27	165.00	196.26	169.52	163.45
Total production/pond/ 7 months (gms)	5067.96	13294.96	3118.16	2754.16	1980	5495.28	1356.16	1307.6
Total production/acre/ 7 months(kg).	170.79	448.04	105.08	92.81	66.726	185.191	45.70	44.066

		All species	All species
Gross Production kg/acre/7 months	=	816.72	341.68
Gross Production (Aprox.) kg/acre/year	=	1400.09	585.74

b) *Fork length :* The average gain in fork length of four fish species were non-significantly different even though *Cirrhina mrigala* gained 19.51 mm/month which was relatively higher than other species.

Table 5. *Mean squares for various characteristics*

S.O.V.	D.F	Mean Squares		
		Gain in Weight	Gain in Fork length	Gain in Total Length
S	3	453.00N.S	157.96**	279.29**
M	6	2945.96**	155.25**	88.46**
T	1	15092.28**	1007.25**	1168.10**
SxM	18	123.82N.S	75.28*	108.44**
SxT	3	121.96N.S	51.95N.S	42.64N.S
MxT	6	725.29*	40.09N.S	16.30N.S
E	18	221.52	24.75	24.93
Total	55			

		Mean values for		
(i)	Species :	Weight gain	Fork length gain	Total length gain
	Catla catla	35.55 a	13.79 b	13.69 b
	Labeo rohita	44.45 a	18.43 a	21.11 a
	Cyprinus carpio	30.99 a	12.71 b	13.36 b
	Cirrhina mrigala	34.88 a	19.51 a	21.40 a
	S. E:	3.977	1.329	1.334
(ii)	Treatments :			
	Treated	52.88 a	20.35 a	21.96 a
	Control	20.05 b	11.87 b	12.82 b
	S. E:	2.812	0.940	0.943
(iii)	Months :			
	Feb.	10.18 c	10.79 c	13.33 c
	Mar.	19.42 bc	15.62 bc	17.00 bc
	Apr.	26.99 b	14.75 bc	16.71 bc
	May	31.93 b	12.50 c	15.49 bc
	June	54.83 a	23.98 a	21.02 ab
	July	59.15 a	19.42 ab	22.73 a
	Aug.	52.77 a	15.72 bc	15.43 bc
	S. E:	5.262	1.758	1.765

* Significant; ** Highly significant; N.S Non significant; M=Months
S.E. Standard Error. ; S=Species ; T=Treatments.

As regards the treatment of pond it caused a highly significant gain comparative to non-treated ponds (20.35 v/s 11.87 mm). Seasonal differences were also highly significant. The months of June and July showed maximum gain in fork length but within these two months difference was insignificant. A minimum fork length was gained during the first and 4th months of study.

The interactions (S x T) were non-significant showing that the fishes included in the study obeyed the general trend of gain in fork length for treatment without any undue effect or interaction of various factors. However, the interaction of species and months (S x M) was significant.

c) *Total length of fishes :* The average gains in the total length of all the 4 species were highly significant. In the treated pond the increase in total length was 21.96 mm and that in the control pond the value remained at 12.82 mm. The difference was found to be highly significant. Seasonal differences were also highly significant. Months of June and July showed maximum gain in total length with no statistical difference between each other.

The interaction (S x T) was non-significant showing no deviation from general trend for treatment in total length gain. The interaction (S x M), between species and months was significant indicating that the response of fishes to gain in total length deviated from the general trend in respect of the seasonal effect and unvariable responses of treated against control ponds during various months of this study.

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