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Comparative Growth and Yield of Exotic Chinese and Indigenous Major Carps under Polyculture System

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ABSTRACT

An experiment was conducted in four earthen ponds to assess the growth and yield of introduced and indigenous major-carps in polyculture system. Fertilization of both treatments was done with cow-dung at the rate of 0.16 g N 100^{-1} g wet fish body weight daily. In treatment -2 (pond-3; P_3 and pond-4; P_4), supplementary feed of 20% crude protein (CP; sunflower meal, rice polish and maize gluten 30%) was given at the rate of 2% of fish body weight, daily by dust feeding method. The feeding was dome at fixed spot and timing to acclimatize the fish and to ensure maximum feed utilization. The net fish production was calculated as 1590.18, 1126.27 kg ha^{-1} $year^{-1}$ in treatment-1 (P_1 & P_2) while 2109.14, 2162.62 kg ha^{-1} $year^{-1}$ in treatment-2 (P_3 & P_4), respectively. Treatement-1 (P_1 & P_2), caused a significant ($P>0.05$) decrease in fish production. With the addition of the supplementary feeding, growth performance of major carps and Chinese carps in treatment-2 (P_3 & P_4) was improved.

Key Words: Major carps; Chinese carps; Polyculture; Supplementary feeding; Growth; Yield

INTRODUCTION

The problem of food shortage in the face of population explosion is becoming more and more critical both in terms of quality and quantity. Millions of the peoples in the world are facing a serious shortage of protein of high biological value. Fish is the best aquatic animal that can help in augmenting protein supply for human use. The choice of fish species is also very important to maximize the production both in terms of quantity and quality (Kumar, 1992). In recent years, some exotic fish species drew attention of the farmers for their better growth performance. Fish culturists introduced several exotic carps in order to obtain more production at minimum cost and shortest period. These included silver carp (*Hypopthalmichthys molitrix*), grass carp (*Ctenopharyngodon idella*) and common carp (*Cyprinus carpio*). Among those, silver carp is the most popular species for its fast growth, lucrative size, good taste and market demand. The changes have caused the extinction of some native fish species (Taylor *et al*., 1984). Traditional polyculture of these food fish was selected on the basis of having excellent culture values, rapid growth, attainment of large size and compatibility.

The fertilizer stimulates the growth of planktons which are natural food for fish. Besides this they improve the hygienic conditions as compared to artificial feeding. The availability of suitable food and ecological conditions for the fish in ponds are the basic needs for running high fish production and protein quality (Hepher & Pruginin, 1981). There is a positive relation between nutrient dynamics and fertilizer application in aquaculture management. Under polyculture system, the use of organic and inorganic fertilizers provide basic nutrients and elements required for the production of phytoplankton and zooplankton that serve as major source of food for fish (Javed, 1988). The production of major carps viz. *Labeo rohita*, *Catla catla* and *Cirrhinus mrigala* could be increased by making available adequate quantities of natural food and balanced artificial diet (Jhingran, 1982). The use of artificial feed in aquaculture practices offers best means of larger fish production within shortest possible time. It is turning of low value sources of nitrogen into quality proteins through simple agricultural practices.

In this context, the present project was planned to evaluate and compare the growth performance and yield of introduced exotic Chinese (*Ctenopharyngodon idella* & *Hypophathalmicthyes molitrix*) and indigenous major carps (*Catla catla*, *Labeo rohita* & *Cirrhinus mrigala*) under polyculture system.

MATERIALS AND METHODS

Experiment was conducted in four earthen ponds each with dimensions 25 m x 8 m x 1.5 m. Fertilization of all four ponds was done with cow-dung at the rate of 0.16 g N 100^{-1} g wet fish body weight daily. *Ctenopharyngodon idella*, *Hypophathalmicthyes molitrix*, *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala* were stocked in the following ratio:

Sr. No.	Fish Species	Treatment-1		Treatment-2	
		P_1	P_2	P_3	P_4
1	*Ctenopharyngodon idella*	10	10	10	10
2	*Hypophathalmicthyes molitrix*	10	30	10	30
3	*Catla catla*	30	10	30	10
4	*Labeo rohita*	15	15	15	15
5	*Cirrhinus mrigala*	10	10	10	10
Total		75	75	75	75

A standard diet was formulated of 20% crude protein using sunflower meal, rice polish and maize gluten 30%. Treatment-2 (pond 3 & 4) was supplemented with 20% CP. Feeding was done at the rate of 2% of wet fish body weight. The amount of feed was increased fortnightly according to the measurement of fresh fish body weight. Fish growth was measured in terms of increase in body weight and total length by random capturing of each fish species from both the ponds on each fortnight, for six months. After obtaining the data, the fish were released back into their respective ponds. The data were subjected to statistical analysis using MSTAT-C and MICROSTAT packages following Steel *et al.* (1996).

RESULTS

After 266 days of rearing, all fish species were harvested from both the treatments. Survival rate for all the fish species was found to be 100% through out the experimental period.

Ctenopharyngodon idella. The initial average body weight of *Ctenopharyngodon idella,* were 25.7±3.27, 24.3±2.25g in treatment-1 (P1& P2) and 26.9±2.11, 25.1±2.58g in treatment-2 (P_3 & P_4), while the final were 448.0±19.84, 547.3±22.08 g in treatment-1 (P_1& P_2) and 685.3±17.89, 647.8±10.56g in treatment-2 (P_3 & P_4), respectively. There were net gains of 422.3, 523.0g and 658.4, 622.7g. The gross fish production was 306.94, 374.94 and 469.91, 443.41 kg ha^{-1} $year^{-1}$ while the net productions was 289.43, 358.44 in treatment-1 (P_1 & P_2) and 450.92, 426.42 kg ha^{-1} $year^{-1}$ in treatment-2 (P3 & P4), respectively (Table I & II).

Hypophathalmicthyes molitrix. The fish having average weights of *H. molitrix* 21.2±1.44, 22.4±2.11 g and 23.3±3.24, 20.7±2.53 g, were stocked initially. However at final harvest, this species had an average final weight of 500.1±11.09, 262.4±12.46 g in treatment-1 (P_1 & P_2) and 612.1±13.44, 479.3±12.06 g in treatment-2 (P3 & P4), respectively. There were net gains of 478.9, 240.0g and 588.8, 458.6 g. The gross fish productions were calculated to be 342.93, 539.39 and 419.92, 986.34 kg ha^{-1} $year^{-1}$ while

Table I. Total fish production in treatment-1

Treatment-1			**Pond-1**					**Pond-2**		
	C. idella	***H. molitrix***	***C. catla***	***L. rohita***	***C. mrigala***	***C. idella***	***H. molitrix***	***C. catla***	***L. rohita***	***C. mrigala***
No. of stocked fishes	10	10	30	15	10	10	30	10	15	10
Survival rate	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Initial average weight (g)	25.7	21.2	25.2	24.9	25.5	24.3	22.4	25.2	23.3	25.4
Final average weight (g)	448.0	500.1	236.2	300.0	401.3	547.3	262.4	189.8	271.9	370.2
Gain average weight (g)	422.3	478.9	211.0	275.1	375.8	523.0	240.0	164.6	248.6	344.8
Gross fish production (kg $pond^{-1}$ 266 d^{-1})	4.48	5.00	7.08	4.50	4.01	5.47	7.87	1.89	4.07	3.70
Gross fish production (kg $pond^{-1}$ $year^{-1}$)	6.14	6.86	9.71	6.17	5.50	7.50	10.79	2.59	5.58	5.07
Gross fish production (kg $acre^{-1}$ $year^{-1}$)	124.27	138.84	196.53	124.88	111.32	151.8	218.38	52.42	112.93	102.61
Gross fish production (kg ha^{-1} $year^{-1}$)	306.94	342.93	485.42	307.46	274.96	374.94	539.39	129.47	278.93	253.44
Net fish production (kg $pond^{-1}$ 266 d^{-1})	4.22	4.78	6.33	4.12	3.75	5.23	2.40	1.64	3.72	3.44
Net fish production (kg $pond^{-1}$ $year^{-1}$)	5.79	6.55	8.68	5.65	5.14	7.17	3.29	2.25	5.10	4.72
Net fish production (kg $acre^{-1}$ $year^{-1}$)	117.18	132.57	175.68	114.35	104.03	145.12	66.58	45.54	103.22	95.53
Net fish production (kg ha^{-1} $year^{-1}$)	289.43	327.44	433.92	282.44	256.95	358.44	164.45	112.48	254.95	235.95
Gross (All Species) fish production (kg ha^{-1} $year^{-1}$)	1717.71					1576.17				
Net (All Species) fish (kg ha^{-1} $year^{-1}$)	1590.18					1126.27				

Table II. Total fish production in treatment-2

Treatment-2			**Pond-3**					**Pond-4**		
	C. idella	***H. molitrix***	***C. catla***	***L. rohita***	***C. mrigala***	***C. idella***	***H. molitrix***	***C. catla***	***L. rohita***	***C. mrigala***
No. of stocked fishes	10	10	30	15	10	10	30	10	15	10
Survival rate	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Initial average weight (g)	26.9	23.3	24.3	24.3	24.7	25.1	20.7	26.3	25.5	26.3
Final average weight (g)	685.3	612.1	324.5	383.0	417.9	647.8	479.3	216.4	380.3	460.8
Gain average weight (g)	658.4	588.8	300.2	358.7	393.2	622.7	458.6	190.1	354.8	434.5
Gross fish production (kg $pond^{-1}$ 266 d^{-1})	6.85	6.12	9.73	5.74	4.17	6.47	14.38	2.16	5.70	4.60
Gross fish production (kg $pond^{-1}$ $year^{-1}$)	9.40	8.40	13.35	7.87	5.72	8.87	19.73	2.96	7.82	6.31
Gross fish production (kg $acre^{-1}$ $year^{-1}$)	190.25	170.01	270.20	159.28	115.77	179.52	399.33	59.91	158.27	127.71
Gross fish production (kg ha^{-1} $year^{-1}$)	469.91	419.92	667.39	393.42	285.95	443.41	986.34	147.97	390.92	315.44
Net fish production (kg $pond^{-1}$ 266 d^{-1})	6.58	5.88	9.00	5.38	3.93	6.22	13.74	1.90	5.32	4.34
Net fish production (kg $pond^{-1}$ $year^{-1}$)	9.02	8.06	12.34	7.38	5.39	8.53	18.88	2.60	7.30	5.95
Net fish production (kg $acre^{-1}$ $year^{-1}$)	182.56	163.13	249.76	149.37	109.09	172.64	382.13	52.62	147.75	120.42
Net fish production (kg ha^{-1} $year^{-1}$)	450.92	402.93	616.90	368.94	269.45	426.42	943.86	129.97	364.94	297.43
Gross (All Species) fish production (kg ha^{-1} $year^{-1}$)	2236.59					2284.08				
Net (All Species) fish (kg ha^{-1} $year^{-1}$)	2109.14					2162.62				

Table III. Analysis of variance on increase in body weight (g) of major carps and Chinese carps in both the treatments

S.O.V.	D.F.	S.S.	M.S.	F. Value
Fortnights (F)	18	41497.237	2305.402	79.7005 **
Treatments (T)	01	2829.373	2829.373	97.8148 **
F x T	18	1189.167	66.065	2.2839 **
Error	38	1099.181	28.926	
Species (S)	04	14029.734	3507.434	153.5564 **
F x S	72	3776.848	52.456	2.2965 **
T x S	04	598.665	149.666	6.5524 **
F x T x S	72	952.893	13.235	0.5794 **
Error	152	3471.884	22.841	
Total	379	69444.982		

**=Highly Significant

Table IV. Comparison of mean values of increase in body weight (g) of major and Chinese carps in the both the treatments

Increase in average body weight		Increase in average body weight	
Species		**Fortnights**	
Ctenopharyngodon idella	29.29 A	17-04-2004	37.47 A
Hypophathalmicthyes molitrix	22.85 B	01-05-2004	36.81 A
Catla catla	20.37 C	15-05-2004	33.42 B
Labeo rohita	16.28 D	29-05-2004	30.90 BC
Cirrhinus mrigala	11.27 E	12-06-2004	30.06 C
		26-06-2004	28.18 C
Treatments		10-07-2004	24.00 D
T_1	17.285 B	24-07-2004	22.83 DE
T_2	22.742 A	07-08-2004	22.62 DE
		21-08-2004	20.35 E
Mean sharing the same letters in a column are statistically non-significant (P>0.05)		04-09-2004	16.98 F
		18-09-2004	15.91 FG
		02-10-2004	13.39 GH
		16-10-2004	11.86 HI
		30-10-2004	9.550 IJ
		13-11-2004	9.170 IJ
		27-11-2004	6.635 JK
		11-12-2004	5.830 K
		25-12-2004	4.280 K

the net productions were 327.44, 164.45 in treatment-1 (P_1 & P_2) and 402.93, 943.86 kg ha^{-1} year^{-1} in treatment-2 (P_3 & P_4), respectively (Table I & II).

Catla catla. The initial average body weights of *C. catla* were 25.2±3.34, 25.2±2.58 g and 24.3±3.32, 26.3±3.25 g while the final average weights were recorded as 236.2±2.84, 189.8±20.92 g in treatment-1 (P_1 & P_2) and 324.5±16.18, 216.4±16.39 g in treatment-2 (P_3 & P_4), respectively. There were net gains of 211.0, 164.6 g and 300.2, 190.1 g. The gross fish productions were calculated to be 485.42, 129.47 and 667.39, 147.97 kg ha^{-1} year^{-1} while the net productions were 433.92, 112.48 in treatment-1 (P_1 & P_2) and 616.90, 129.97 kg ha^{-1} year^{-1} in treatment-2 (P_3 & P_4), respectively (Table I & II).

Labeo rohita. The fish having average weights of *L. rohita* 24.9±1.81, 23.3±3.21 g and 24.3±3.78, 25.3±3.16 g were stocked initially; however at final harvest, *L. rohita* had an average final weight of 300.0±24.23, 271.9±11.49 g in treatment-1 (P_1 & P_2) and 383.0±9.80, 380.3±14.28 g in treatment-2 (P_3 & P_4) respectively. There were net gains of 275.1, 248.6 g and 358.7, 354.8 g. The gross fish productions were calculated to be 307.46, 278.93 and 393.42, 390.92 kg ha^{-1} year^{-1} while the net productions were 282.44, 254.95 in treatment-1 (P_1 & P_2) and 368.94, 364.94 kg ha^{-1} year^{-1} in treatment-2 (P_3 & P_4) respectively (Table I & II).

Cirrhinus mrigala. The initial average body weights of *C. mrigala* were 25.5±0.93, 25.4±1.92 g and 24.7±3.43, 26.3±3.45 g while the final average weights were recorded as 401.3±19.84, 1370.2±15.18 g in treatment-1 (P_1 & P_2) and 417.9±13.35, 460.8±8.75 g in treatment-2 (P_3 & P_4), respectively. There were net gains of 375.8, 344.8 g and 393.2, 434.5 g. The gross fish productions were calculated to be 274.96, 253.44 and 285.95, 315.44 kg ha^{-1} year^{-1} while the net productions were 256.95, 235.95 in treatment-1 (P_1 & P_2) and 269.45, 297.43 kg ha^{-1} year^{-1} in treatment-2 (P_3 & P_4), respectively (Table I & II).

The gross fish productions for all the fish species together, were calculated to be 1717.71, 1576.17 kg ha^{-1} year^{-1} in treatment-1 (P_1 & P_2) and 2236.59, 2284.08 kg ha^{-1} year^{-1} in treatment-2 (P_3 & P_4) respectively. However, the net fish production for the five species was 1590.18, 1126.27 kg ha^{-1} year^{-1} in treatment-1 (P_1 & P_2) and 2109.14, 2162.62 kg ha^{-1} year^{-1} in treatment-2 (P_3 & P_4) respectively (Table I & II).

The Analysis of Variance indicated that the fortnights and the species had significant ($P < 0.01$) difference. However *H. molitrix* best overall weight gain. The interactions of fortnights and species (F x S) and among the fortnight, treatment and species were significant while between fortnights and treatment (F x T) and treatment and species (T x S), were non-significant (Table III). Comparison of means of increase in average total length for the species, treatment and fortnights shows that means sharing the same letter differ non-significantly while those having different letters, differ significantly (Table IV).

DISCUSSION

Supplementary feed has profound effect on the growth of fish Javed *et al*. (1993). In present investigation, treatment-2 (P_3 & P_4) fed with supplementary feeding was higher than treatment-1 (P_1 & P_2) without supplementary feeding. Ibrahim *et al*. (2000) observed better growth performance of fish under the influence of feed containing 30% CP in earthen ponds. Their results were in agreement with the present investigation.

Ansal *et al*. (2000) reported that the performance of exotic fishes in our aquaculture system has been quite encouraging. During the present investigation treatment-1 (P_1 & P_2) *H. molitrix* grow more than the *C. catla*. The increased growth rate of silver carp in the polyculture was higher, which may be due to feeding vigor and competition exhibited by silver carp with native species *C. catla*.

In the present investigation *C. mrigala* gained better weights than *L. rohita* and *C. catla* in treatment-2 (P_3 & P_4). Growth performance of *C. mrigala* in terms of total length gain was also better than that of *L. rohita* and *C. catla*. Mahmood (2001) reported better growth of *C. mrigala* than *L. rohita* and *C. catla* under the influence of feed containing 30% C.P. Ali *et al*. (2003) reported positive correlation between feed added and weight gain in all the treatments. Specific growth rate was maximum in *C. mrigala* followed by *L. rohita* and *C. catla*. The increase in total length of *C. mrigala* was better than the other two species. Mahmood (1997) and Ahmed (1996) reported maximum increments in terms of fork length and total length in *C. mrigala* followed by *L. rohita* and *C. catla*. This could be due to the inherent potential of *C. mrigala* to attain larger fork length and total length in fertilized ponds (Javed, 1988).

Javed *et al.* (1990) found that manure increased the body weight, fork length and total length of *L. rohita*, *C. catla*, *C. mrigala*, *H. molitrix* and *Ctenopharyngodon idella*. Similar results were found during the present investigation. Taignides (1978) observed that animal manure contains the major inorganic nutrients (N. P. K.) along with trace elements as Ca, Mg, Cu and Zn that increase the natural productivity of pond. Treatment-2 showed better net fish yield (4271.76 kg ha^{-1} $year^{-1}$) than that of treatment-1 (2716.45 kg ha^{-1} $year^{-1}$). Garg and Bhatnagar (2000) reported high fish yields from the ponds fertilized with cowdung, triple super phosphate and urea also.

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