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Effects of Hardness on the Growth Performance of Rohu (*Labeo Rohita*) and its Hybrid

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ABSTRACT

An experiment was conducted to study the growth performance of the two fish varieties *viz*; Rohu (*Labeo rohita*) and its Hybrid (*Labeo rohita* ♂ x *Catla catla* ♀) for a period of 44 days at four hardness levels (150, 300, 450 and 600 mg/L) in the cemented tanks each having capacity of 1500 L of water. Total body weight significantly differed by hardness treatments, however a non–significant difference in total gain in body weight and gain/unit of body weight of both varieties was noted. Growth in terms of body lengths (total and fork) was also highly significantly different, while it was also non–significant in terms of total gain and gain/unit of lengths at different hardness levels. Growth of both varieties in terms of all the parameters was highly significantly different with time. The growth rate of rohu gradually increased up to 450 (mg/L) then onward decreased. The growth rate of hybrid remained almost similar in all the experimented hardness levels. The important physico-chemical characters of the treatments remained non-significantly different, however, the differences were significant with reference to time scale.

Key Words: Major Carps; *Labeo rohita* hybrid; Growth performance; Hardness

INTRODUCTION

The hardness of the water is a serious problem in the fish production, in central Punjab, which varies considerably from place to place. In general, surface water is soften than ground water. The hardness of water reflects the nature of geological formations with which it has been contacted. Hardness is caused by divalent cat-ions; such ions are capable of reacting with soap to form precipitate, and with certain anions, present in the water, to form scales. Calcium and magnesium, which are the major causing agents of hardness, play not only osmotically active role in the life of fish but also act as key nutrients for photosynthetic life. Calcium is necessary for blood coagulation and compliment activation (Yano *et al*., 1985). Calcium is most directly involved in the development and growth of skeleton, and it plays important role in many other biochemical reactions. Acidity of acidified lakes becomes decreased by the addition of calcium. Increased levels of calcium also seem to decrease stress effects of low pH levels (Brown 1983). Calcium acts as antidoting agent and reduces the toxicity of the heavy metals. It also shows antagonistic effects of histamine release, granulocyte chemotoxic, phagocytosis and calcium ATPase activity of erythrocyte membranes (Brewer *et al*., 1983). Its excess can cause renal stone and its deficiency can cause osteoperosis, rickets and hypoparathyroidism. Excess amount of calcium in water is also not healthy sign. Its presence beyond certain limits not only creates problems for human life and industry but also to fish as well. Its limiting effects in terms of growth and survival greatly vary with species, age, physiological state of fish and environmental conditions.

Keeping in mind, the higher hardness values of the ground water of the area, the efforts are being made to evaluate its potential with special reference to pond fisheries. So the present experiment was designed to study the effect of different levels of hardness on the growth performance of two freshwater fish varieties *viz*; Rohu (*Labeo rohita*) and its Hybrid (*Labeo rohita* ♂ x *Catla catla* ♀).

MATERIALS AND METHODS

The experiment was run in the wet laboratory of Fisheries Research Farms, Department of Zoology & Fisheries, University of Agriculture, Faisalabad. Ten fingerlings of each fish varieties *viz*; Rohu (*Labeo rohita*) and its Hybrid (*Labeo rohita* ♂ x *Catla catla* ♀) were stocked in each of the four cemented tanks having dimensions 300 x 85 x 60 cm (1500 L of water) each.

The fishes were acclimatized in available canal water having 150 mg/L average hardness value, for a period of approximately one month. Commercial grade $CaCl_2$ was used to increase hardness of the experimental water. No $CaCl_2$ was added in the first tank (control, hardness; 150 mg/L). Total hardness levels of 300, 450 and 600 mg/L was produced in the second, third and fourth tank by adding appropriate amount of $CaCl_2$ in each, respectively. Electrical conductivity value of water of each tank was readjusted by adding appropriate amount of NaCl. Prior to stocking, body weight, total length and fork length of fish of both varieties were measured and recorded.

All fishes were fed with 21% protein, manually grinded, artificial feed, twice a day at the rate of 10% of

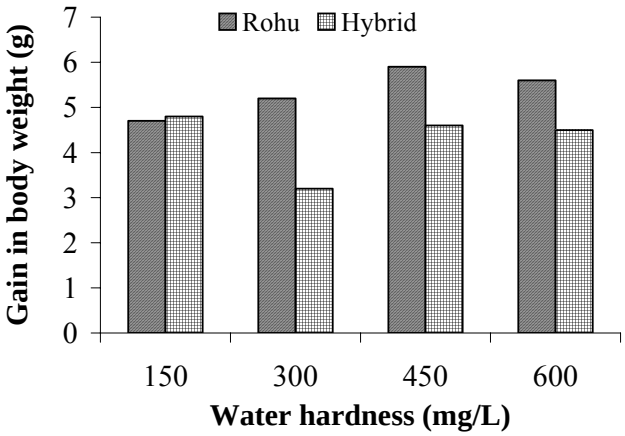
body weight daily. The tanks were supplied with pumped air to keep the dissolved oxygen level close to saturation.

The fish growth in terms of body weight, fork length and total length were recorded after every 96 h for the period of 44 days. Water quality parameters such as temperature, dissolved oxygen, electrical conductivity and pH were also recorded after every 96 h for the whole experimental period. The effect of various hardness concentrations on the growth of two experimental fish species was statistically established with help of analysis of variance. The important physico-chemical parameters were also compared with the help of analysis of variance.

RESULTS AND DISCUSSION

The initial average body weight of rohu in the all four treatments was 5.0, 7.0, 4.6 and 4.9 g and final average weight was observed as 9.7, 12.2, 10.5 and 10.5 g respectively (Table I). Net gain in average weight of rohu was 4.7, 5.2, 5.9 and 5.6 g; while gain /unit was 0.69, 0.64, 0.91 and 0.91 g in all four treatments respectively (Table I). The initial average body weight of hybrid in four treatments was 4.5, 5.5, 8.7 and 5.0 g while the final average weight was 9.3, 8.7, 13.3 and 9.5 g respectively. Net gain in average body weight of hybrid was 4.8, 3.2, 4.6 and 4.5 g; while gain /unit was 0.80, 0.54, 0.43 and 0.66 g in all four treatments respectively. The initial average fork length of rohu in four treatments was 6.8, 7.5, 6.5 and 6.6 cm respectively, while the final fork length was 8.3, 8.8, 8.5 and 8.3cm respectively (Table I). Net gain in average fork length of rohu was 1.5, 1.3, 2.0 and 1.7 cm; while gain /unit was 0.20, 0.17, 0.26 and 0.23 cm in all four treatments respectively (Table I). The initial average fork length of hybrid in four treatments was 6.2, 6.5, 7.7 and 6.3 cm respectively while the final fork length was 7.9, 7.7, 8.8 and 7.8 cm respectively. Net gain in average fork length of hybrid was 1.7 cm, 1.2 cm, 1.1 cm and 1.5 cm; while gain/unit was 0.25, 0.17, 0.12 and 0.21 cm in all four treatments respectively. The initial average total length of rohu in four treatments was 7.8, 8.7, 7.7 and 7.8 cm respectively while the final total length was 9.6, 10.2, 9.7 and 9.6 cm respectively. Net gain in average total length of rohu was 1.8, 1.5, 2.0 and 1.8 cm; while gain/unit was 0.20, 0.22, 0.24 and 0.20 cm in all four treatments respectively. The initial average total length of hybrid in four treatments was 7.3, 7.7, 9.0 and 7.4 cm respectively, while the final total length was 9.2, 9.0, 10.3 and 9.1 cm respectively. Net gain in average total length of hybrid was 1.9, 1.3, 1.3 and 1.7 cm; while gain/unit was 0.23, 0.22, 0.13 and 0.21 cm in all four treatments respectively (Table I).

Fig. 1. Comparison of growth of rohu (*Labeo rohita*) and its hybrid at different hardness levels



Highly significant difference in growth of total body weight was observed under different hardness regimes. The rohu showed maximum growth at 300 mg/L; however, it is interesting to note that its hybrid performed best at 450 mg/L, hardness level (Table I, Fig. 1). A non-significant difference in terms of total gain in body weight and gain/unit of body weight of both species in different treatments was observed (Table II). Growth in terms of body lengths (total & fork) was also highly significantly different, while it was also non-significantly different in

Table I. Growth of two fish varieties *viz*. rohu (*Labeo rohita*) and its hybrid under various water hardness levels

Growth parameters		Water Hardness Levels (mg L^{-1})							
		150		300		450		600	
		Rohu	Hybrid	Rohu	Hybrid	Rohu	Hybrid	Rohu	Hybrid
Body Weight (g)	Initial	5.0	4.5	7.0	5.5	4.6	8.7	4.9	5.0
	Final	9.7	9.3	12.2	8.7	10.5	13.3	10.5	9.5
	Total Gain	4.7	4.8	5.2	3.2	5.9	4.6	5.6	4.5
	Gain/Unit	0.69	0.8	0.64	0.54	0.91	0.43	0.91	0.66
Fork Length (cm)	Initial	6.8	6.2	7.5	6.5	6.5	7.7	6.6	6.3
	Final	8.3	7.9	8.8	7.7	8.5	8.8	8.3	7.8
	Total Gain	1.5	1.7	1.3	1.2	2.0	1.1	1.7	1.5
	Gain/Unit	0.20	0.25	0.17	0.17	0.26	0.12	0.23	0.21
Total Length (cm)	Initial	7.8	7.3	8.7	7.7	7.7	9.0	7.8	7.4
	Final	9.6	9.2	9.0	9.0	9.7	10.3	9.6	9.1
	Total Gain	1.08	1.9	1.3	1.3	2.0	1.3	1.8	1.7
	Gain/Unit	0.20	0.23	0.22	0.22	0.24	0.13	0.20	0.21

Table II. Analysis of variance on gain in body weight, fork length and total length of rohu (*Labeo rohita*) and its hybrid

		Mean Sum of squares								
		Weight			Fork Length			Total Length		
S.O.V.	d.f.	Total Wt.	Total Gain	Gain/ Unit	Total FL.	Total Gain	Gain/ Unit	Total TL.	Total Gain	Gain/ Unit
Time	8	27.691**	0.972**	0.028**	2.769 **	0.118 *	20.719**	3.476 **	0.207 **	0.003 **
Treatment	3	17.973**	0.67 ^{NS}	0.002 ^{NS}	1.550 **	0.008 ^{NS}	2.407 ^{NS}	2.229 **	0.008 ^{NS}	0.000 ^{NS}
Time x Treatment	24	0.210 ^{NS}	0.309 ^{NS}	0.008 ^{NS}	0.024 ^{NS}	0.056 ^{NS}	10793 ^{NS}	0.022 ^{NS}	0.062 *	0.001 *
Species	1	2.738**	0.211 ^{NS}	0.007 ^{NS}	1.682 **	0.020 ^{NS}	4.500 ^{NS}	1.431 **	0.011 ^{NS}	0.000 ^{NS}
Time x Species	8	0.382 ^{NS}	0.166 ^{NS}	0.004 ^{NS}	0.042 ^{NS}	0.030 ^{NS}	4.969 ^{NS}	0.028 ^{NS}	0.016 ^{NS}	0.000 ^{NS}
Treatment x Species	3	28.806**	0.031 ^{NS}	0.003 ^{NS}	2.312 **	0.012 ^{NS}	2.463 ^{NS}	3.590 **	0.006 ^{NS}	0.000 ^{NS}
Error	24	0.182	0.252	0.005	0.030	0.042	8.015	0.019	0.029	0.000
Total	71									

^{NS}: Non Significant, *Significant; **: Highly Significant; Level of Significance =5%

Table III. Experimental mean values of important water quality parameters for various water hardness treatments

	Water Hardness levels (mg L^{-1})			
	150	300	450	600
Temperature (C^o)	30.4 (28.4-33.1)	30.5 (28.6-33.1)	30.4 (28.7-32.9)	30.3 (28.8-33.0)
Dissolved Oxygen mg/L	3.5 (2.9-4.8)	3.6 (3.0-4.9)	3.6 (3.0-5.0)	3.4 (2.9-4.9)
Salinity (%)	0.073 (0.07-0.08)	0.074 (0.07-0.08)	0.074 (0.07-0.08)	0.075 (0.07-0.08)
pH	8.07 (8.0-8.2)	8.07 (7.9-8.2)	8.07 (7.9-8.2)	8.1 (8.0-8.2)

Values in parentheses showing the range

terms of total gain and gain/unit at different hardness levels. Growth in terms of all the recorded growth parameters was also highly significantly different with regards to time. The important physico-chemical characters of the experimental tanks fluctuated non-significantly showing that physico-chemical characters of the treatments of different hardness levels has little or no effect, on fish growth (Table III). Frances (1972) demonstrated little beneficial or determinental effects of increased water hardness and salinity on the survival and growth of stripped bass fry within a range of 30 to 175 mg/L of total hardness and 1100 to 1500 mg/L of Chlorides. The percentage survival of fry decreased in water with added salinity but conflicted results were obtained with added total hardness. Water with added total hardness and added salinity resulted in a slight increase in growth as compared to untreated water. Boyed (1981) and Jhingran (1982) having the view that water containing lower values of hardness (20 mg/L), effect the production and may need liming and calcium fertilizers. Piper *et al*. (1983) had the opinion that fish grow well over a wide range of alkalinities and hardness but values of 120 to 400 ppm are optimum, However the present study hints that even higher values of hardness are more favorable or at least no determinental effect on the growth of major carps in prevailing slightly saline conditions.

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