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Umita Sah
Regional Agriculture Research Station, Tarahara, Sunsari, Nepal

Yuktilal Mukhiya
Regional Agriculture Research Station, Tarahara, Sunsari, Nepal

Suresh K Wagle
Fisheries Research Division, Godawari, Lalitpur, Nepal

Correspondence
Umita Sah
Regional Agriculture Research Station, Tarahara, Sunsari, Nepal

Comparative evaluation of genetically improved and farmed rohu (*Labeo rohita*) on growth and yield at initial stage of rearing

Umita Sah, Yuktilal Mukhiya and Suresh K Wagle

Abstract
An experiment was carried out at Regional Agricultural Research Station (RARS), Tarahara, Nepal for 90 days during September to December 2015 to evaluate the performance of farmed Rohu (FR, *Labeo rohita*) and genetically improved strain of Rohu (GIR). Fry with an initial mean weight of 1.74±0.4 g and 1.35±0.4 for GIR and FR were stocked in replicated ponds at density 20000 fry/ha. Fry were fed at 5% of their total biomass daily with a ration containing 22% crude protein. Absolute weight gain, relative and specific growth rates were significantly ($P<0.05$) higher in GIR. Survival rate of GIR and FR was 90.1±4.4% and 79.1±3.7%, respectively, at harvest after 90 days of rearing and the differences in survival rate was not significantly different ($P>0.05$). Gross yield of 2223.8 kg/ha for GIR was significantly ($P<0.05$) higher than the gross yield of 338.4 kg/ha for FR. Fish body length and weight coefficient was within the range of standard value for GIR (2.8) and FR (2.4) remained below standard value. The preliminary findings of the present investigation revealed that genetically improved rohu had a superior performance on growth and yield over the farmed rohu.

Keywords: growth, *Labeo rohita,* specific growth, strains, yield

1. Introduction

Indigenous major carps including Rohu (*Labeo* rohita) are the major group of fish species in polyculture fish farming systems of Nepal [1]. Existing stock of Rohu is the several generations descendent of the stocks introduced in Nepal some 60 years' back. Genetic management these stocks have not been practiced rather focusing on seed multiplication [2]. As a results of poor genetic management of cultivated stock, low effective population sizes over successive generations lead to inbreeding depression with reduced growth rates, loss of fecundity and poor survival [3]. Many hatcheries function as isolated, genetically closed, units raising their own replacements to produce seed for grow out culture. The number of replacement brood stock used is very limited, hence inbreeding builds up in those stocks [4]. It was estimated that the rate of inbreeding accumulation by 1.6% to 27.6% per year in many hatcheries of Nepal[1]. Unsubstantiated claims that stock deterioration in hatchery population of Rohu due to poor broodstock has been often reflected in farmers' complaints in terms of retarded growth, reduction in reproductive performance, morphological deformities, increased incidence of disease and mortality of hatchery produced carp seeds in the country. The types of traits most frequently reported to show inbreeding depression in fish species have been: increased fry abnormalities [5, 6], reduced survival [5], reduced growth rate [7, 8] and lowered reproductive success [5, 9]. In addition, Rohu appears to grow slower than other Indigenous Major carps (Naini and Catla) in polyculture system.

To overcome the problem of slow growth and inbreeding depression with existing hatchery stocks of Rohu (FR), a new strain of Rohu (GIR) developed from selective breeding program has recently been obtained at Regional Agricultural Research Station, Tarahara, Nepal with the assistance of Food and Agriculture Organisation (FAO) and Fisheries development Training centre (FDTC), Janakpur, Nepal in August 2013. It has been reported that this strain has genetic gain of 18 % per generation for growth trait after nine generations of selective breeding [10]. However, the growth performance of GIR and FR has not been evaluated in local environment. Thus, the objective of present study was to compare and evaluate the growth and yield performance of genetically improved and farmed Rohu (Labeo rohita) at initial stage of development.

2. Materials and Methods

An experiment was conducted on the growth performance of genetically improved Rohu (GIR) and farmed Rohu (FR) at Regional Agricultural Research Station (RARS), Tarahara, Nepal for 90 days during September to December 2015. Fry of both GIR and FR was obtained from the captive breeding of respective strains of Rohu conducted at RARS, Tarahara, Nepal. The growth experiment of FIR and GR as treatments was conducted in completely randomized design (CRD) with three replicates. The fry with an average weight of 1.74±0.4 g for GIR and 1.35±0.4 for FR was stocked at a density of 2 fish/m^2 in duly prepared respective ponds. The size of ponds was 100 m^2 and the water level maintained was 90.0 cm throughout the experimental period. The fish were fed daily with a pellet ration containing 22% protein at 5% of total body weight.

Monthly growth check was carried out by sampling 20% of the standing biomass. Sample fish biomass were netted monthly for growth check. Survival and yield data were obtained upon harvest by complete drying of each experimental ponds. Water quality parameters: temperature (daily), dissolved oxygen (DO) and pH were measured at weekly interval to correlate the growth of fish with their rearing environment.

3. Statistical analysis

Data processing and illustrations were performed using Microsoft excel. Differences between treatments were analyzed with Student t-test using SPSS ver. 20.

4. Results and Discussion

The value of water quality parameters of the ponds was ranged between 15 to 24 ºC temperature, 4.0 to 8.3 mg/L dissolved oxygen and 7.2 to 8.5 pH during the experimental period. Water temperature declined at later stage of experiment which might have affected the growth of fish fry.

The body weight gain and length of GIR and FR in different periods are given in Table 1. The differences in weight gain and increase in body length between GIR and FR in all growth sampling period was significantly different (P<0.05). FIR has demonstrated 74.5 times increase in body weight while the body weight of FR increased only 17.6 times during 90 days of growing period. Mahapatra *et al*. observed that the growth rate superiority of GIR up to 75% to the growth rate of local Rohu [10]. Roy *et al*. also reported similar trends of weight gain differences between GIR and FR [11]. Sarkar *et al* observed genetically improved Rohu having 17% growth advantage over normal Rohu which growing importance over normal Rohu due to high growth rate and consumer preference [13]. Corresponding to body weight gain, the total length of FIR significantly (P<0.05) increased at each growth sampling period to that of the length of FR.

Table 1: Weight gain of GIR and FR at different time interval

Growing day	Weight, g		Length, cm	
	GIR	FR	GIR	FR
1	1.7±0.4^a	1.3±0.4^b	4.7±0.5^a	4.3±0.6^b
30	5.8±1.6^a	4.1±1.5^b	7.4±0.7	6.1±1.1^b
60	92.1±37.6^a	14.9±11.7^b	19.3±2.7^a	10.7±3.1^b
90	126.6±48.1^a	22.9±12.9^b	21.1±2.5^a	12.1±2.5^b

Different superscripted letters within row are significantly different at α0.05.

Fig 1 showed that the growth of both GIR and FR for the first 30 days of rearing was almost stagnant. Later, the growth curve inclined sharply for GIR and the fish grew exponentially while the growth curve of FR remained linear at lower level.

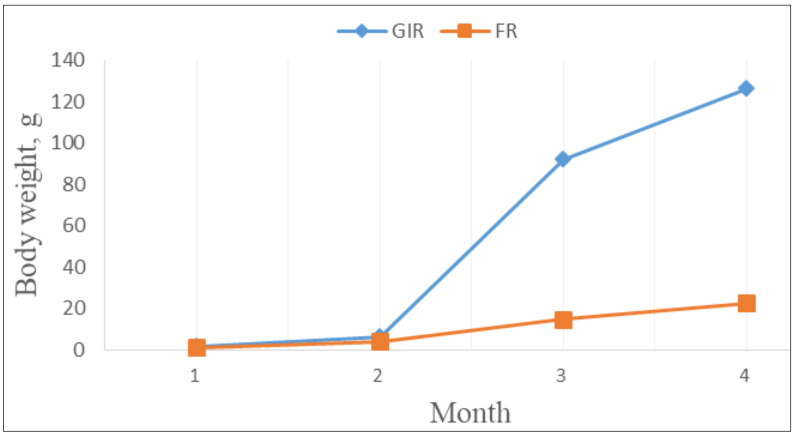

Fig 1: Growth trend of genetically improved Rohu (GIR) and farmed Rohu (FR) during the experimental period

Growth rates (absolute, relative and specific) measured at different time intervals and the mean growth rates all were significantly high (P<0.001) in GIR compared to the growth rates of FR (Table 2). Mean absolute growth rate was 1.37 g and 0.24 g/day for GIR and FR, respectively. FIR grew by 83.4% while relative growth of FR was 19.6% per day. Specific growth rate (SGR) of genetically improved Rohu increased sharply up to 60 days of rearing and later the SGR decreased sharply for both strains of Rohu. The SGR of Rohu measured in this study did not follow the general trend of decrease in SGR as fish size increased over the rearing period which was reported by Wagle and Shrestha *et al*, [12].

Survival rate of GIR and FR was 90.2±4.5% and 79.2±3.7%, respectively, at harvest after 90 days of rearing and the differences in survival rate was not significantly different (P>0.05). The mortality of fish was occurred during the experimental period due to predation by birds in relatively small experimental ponds. Jha DK *et al* survey revealed that average survivals of hatchlings, fry and advanced Fry ranged from 22-28%, 50-53% and 60-65% respectively. The mortality occurred due to problems of asphyxiation, predatory aquatic insects, frogs, water snakes and piscivorous birds during nursing [15].

The extrapolated yield (2223±82 kg/ha) of GIR was significantly higher (P<0.01) the yield (338.4 kg/ha) of FR. In this study the fish was fed with a pellet ration containing 22% of crude protein which resulted in 6.5 fold increase in yield of GIR over the yield of FR indicating that genetic potential for growth of GIR is high if environmental conditions are favourable. In a diet evaluation experiment, Sarkar *et al* found 25% dietary protein is optimum for the growth of GIR [13]. Studies are warned on feeds and feeding practices to further exploit the genetic potential of GIR in terms of growth and yield.

Table 2: Growth rates and yield of genetically improved Rohu (GIR) and farmed Rohu (FR) at different rearing time intervals

Rearing day	Growth rates						Yield, kg/ha		Survival %	
	Absolute, g/day		Relative, %		Specific, %					
	GIR	FR	GIR	FR	GIR	FR	GIR	FR	GIR	FR
30	0.13	0.09	8.69	8.04	4.03	3.67				
60	2.87	0.36	54.97	10.41	9.19	4.34				
90	1.09	0.28	10.35	6.39	1.06	1.42				
Mean±St. dev	1.37 ±0.52	0.24 ±0.14	83.45 ±38.3	19.64 ±13.3	4.17 ±0.48	2.72 ±0.62	2223 ±82.0	338.4 ±6.0	90.2 ±4.5	79.2 ±3.7
P value	0.001		0.001		0.001		0.001		0.068	

The relationship of fish lengths and weights expressed by power functions revealed that the power value (2.8) was within standard for GIR, whereas the power value (2.4) of FR was slightly below the standard value (Fig 2). Hopkins suggest that slope of the length weight regression line when applying power function should have values between 2.5 to 3.5 with the high correlation coefficient (>0.9) for aquacultured fish species [14].

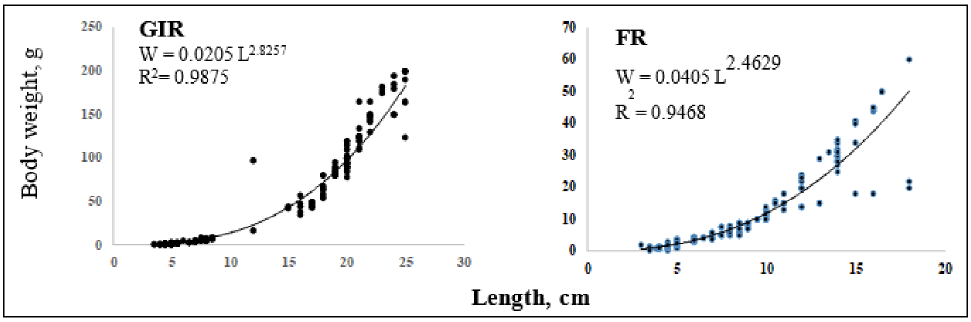

Fig 2: Condition co-efficient of genetically improved Rohu (GIR) and farmed Rohu (FR)

5. Conclusion

Body weight gain and gross yield of genetically improved Rohu was significantly higher than the growth and gross yield of farmed Rohu. Survival rate of genetically improved Rohu and Farmed Rohu was not significantly different.

Biological potential of genetically improved Rohu has yet to be exploited through improvement in feed and rearing environment.

6. Acknowledgement

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