The Pharma Innovation Journal 2022; SP-11(7): 3503-3506

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(7): 3503-3506

www.thepharmajournal.com
Received: 08-04-2022
Accepted: 11-05-2022

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Comparative study of somatic growth performance of amur carp with Indian major carps in North Bihar, India

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Abstract
The current study examined the somatic growth of major carp (*Gibelion catla* and *Labeo rohita*) and Amur carp (*Cyprinus carpio haematopterus*) in a polyculture system over the course of five months in earthen ponds. For a comparative study in polyculture with three replicates, stocked Amur carp: Catla: Rohu in 40:40:20 ratios. Amur carp stocked with Silver barb (*Puntius gonionotus*) in 1:1 ratio in another pond with replicates. Results showed that Amur carp had greater mean net weight, mean net length, and specific growth rates than Catla and Rohu. There were no discernible variations between the trails in terms of survivability. The outcomes showed that Amur carp performs better in a polyculture system than major and minor carps.

Keywords: Somatic growth performance, amur carp, Indian major carps, polyculture system, minor carps

Introduction
The contribution of carps to India's total aquaculture production is around 85%. Three IMCs, *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala* add significantly to major creation in India (Laxmappa, 2014) [1]. Over the years, minor carps have also been effectively introduced into carp polyculture systems in India through a variety of techniques. These fish are in more demand from consumers, have a better market value, and have equivalent growth potential across the nation. Additionally, it is well acknowledged that *Labeo rohita* and *Gibelion catla* are the two fish species grown most frequently in carp polyculture systems. Despite the fact that, Rohu is currently very well-liked by peoples since to its high price and consumer preference, many smallholder are disenchanted with Rohu because of their deliberate somatic growth rate and difficulty of administering them in a polyculture method. When Rohu was cultivated with Amur carp, stocking densities predicted increased yields.
Amur carp is superior strain of common carp of Hungarian provenance. Due to its superior growth performance, late maturation, hardiness, acceptance of artificial feed, and similar food patterns to current stock, it has higher convenient value in aquaculture techniques (Basavaraju and Reddy, 2013) [2]. The somatic growth of Amur carp and IMCs were compared in the current study under the climatic circumstances of North Bihar.

Materials and Methods
The present study was conducted to assess the somatic growth recital of Amur carp under polyculture system with *Gibelion catla*, *Labeo rohita* and *Puntius gonionotus* in different earthen ponds during February, 2021 to June, 2021. Size of pond was 0.04 ha with 1.0 meter water depth. Stocking ratio (Amur carp: Catla: Rohu) was 40:40:20 and (Amur carp: Silver barb) was 1:1. Stocking density was 500 numbers (@12,000/ha) in each pond. Feeding was carried out with rice bran and mustard oil cake in 1:1 ratio @ 4% of total body weight. With the appropriate tools and chemicals, water quality parameters were checked every two weeks (APHA, 1989) [3]. The fish were caught using a drag net and the growth characteristics were evaluated after a four-month culture period. Data on fish growth were gathered from pond and standard research procedures were used to determine the somatic growth gain.

1. The Net Weight Gain (NWG) in grams was determined using following equation:
   NWG = Final body wt. (g)-Initial body wt. (g)

2. The Net Length Gain (NLG) in cm was determined using following equation:
   NLG = Final total body length (cm)-Initial total body length (cm)
3. Specific Growth Rate (SGR) was determined using following equation:

$$SGR = \frac{\text{In log (final weight)-In log (initial weight)}}{\text{Time (days)}}$$

Statistical analysis

To draw a precise conclusion, the study's data were analyzed for specified statistical parameters (such as mean, range, and standard deviation).

Results and Discussion

Figure 1 shows the outcomes of physico-chemical parameters. During the culture phase, it was observed that every water quality parameter was within permissible limits. All of the ponds' water pH values during the study ranged from 6.9 to 7.1, which is ideal for fish development and survival (Swingle, 1961) [4]. The dissolved oxygen (DO) value was around 6.5 ppm, which was in an acceptable range and apposite for growth of fish (Jhingran, 1982) [5].

The data pertaining to growth of Amur carp and IMCs *viz. Gibelion catla* and *Labeo rohita* are accessible in Table 1 and Fig 2. Amur carp had shown the highest growth (237.24 g and 24.06 cm respectively) followed by Catla (153.91 g and 21.68 cm) and Rohu (130.16 g and 20.89 cm respectively). The specific growth rate of Amur carp was highest (1.01) followed by Catla (0.76) and Rohu (0.69). The Specific Growth Rate (SGR) was high in Amur carp compared to Catla and Rohu, which was suggested that Amur carp were raised in polyculture with Indian major carps and had improved primary production as a result of their burrowing habits.

However, when compared to Silver barb and Amur carp (Table 2 and Fig. 3), both fishes interact well together. Amur carp showed the somatic growth (223.91 g and 23.14 cm) and Silver barb (230.17 g and 23.91cm). The SGR of Amur carp and Silver barb was 0.96 and 0.97 respectively. The bottom-feeding habits of Amur carp and Silver barbs, which trigger the liberate of nutrients from pond bottoms and boost productivity and, as a result, greater output, are another potential cause.

This finding is consistent with one research, in which discovered that Amur carp exhibited greater mean weight gains than other carps in seasonal waterbodies in Chamrajnagar district, Karnataka (Rajanna *et al*., 2019) [6]. In a polyculture system, Amur carp grew more quickly than other carps (Hari and Sagar, 2018) [7]. This data is consistent with those brought to light by Basavaraju *et al*. (2012) [8], who demonstrated that Amur carp growth outpaced that of common carp. According to Sharma (2012) [9], the Amur strain of common carp is a suitable replacement for the common carp. Due to its greater growth potential, it is currently used in composite cultures.

The dominance of feed consumption, reduced interspecies competition for preferred natural food, and burrowing behaviour, which results in the release of nutrients from the pond bottom and unpleasant gases from the bottom and increases productivity and leads to a better yield, may all contribute to the Amur carp's higher weight gain. Common carp's stirring activities caused the phenomena of nutrient release in the pond bottom, which has been well-documented (Milstein *et al*., 1992, Wahab, 1995 and Rahman, 2008) [10, 11, 12].

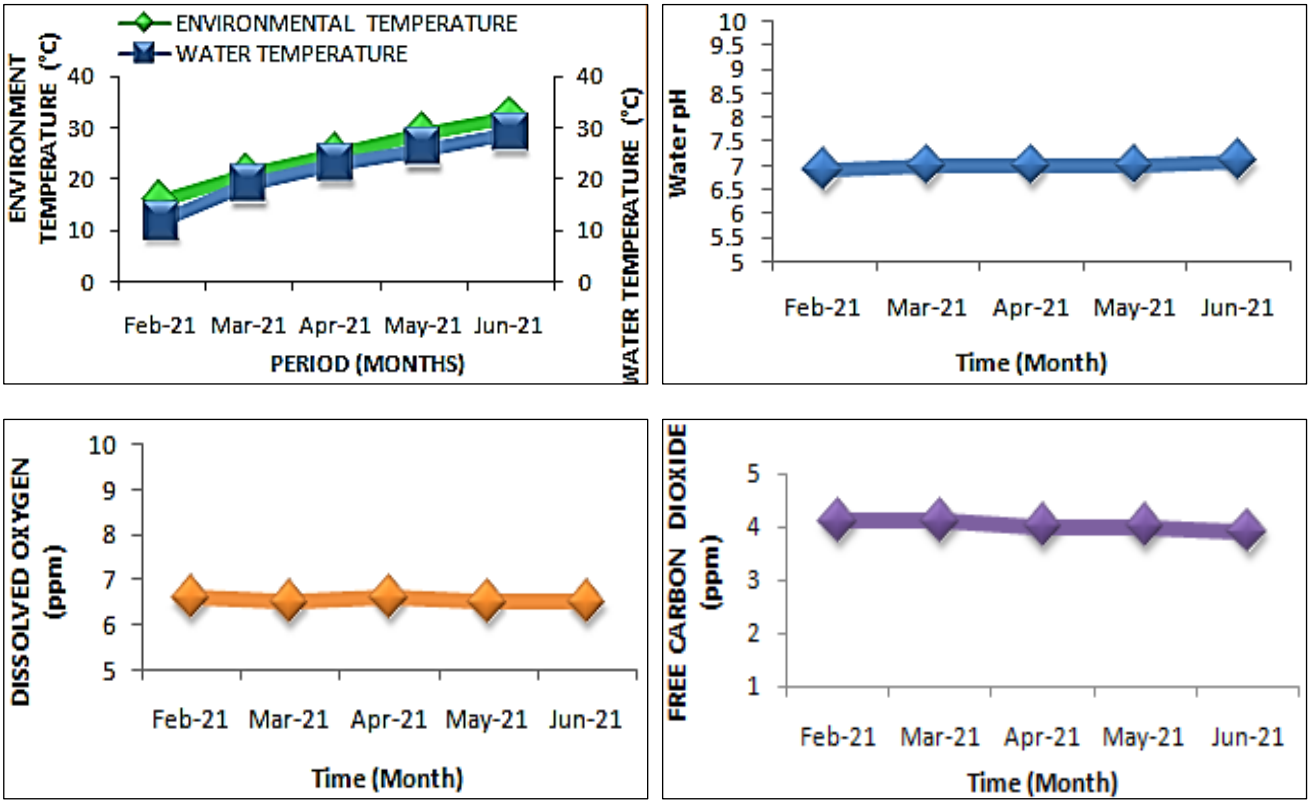

Fig 1: Water quality parameters during February 2021 to June 2021

Table 1: Somatic growth parameters of carps (Amur carp, Catla and Rohu) in earthen ponds during study period

Species	Body weight (gm)			Body length (cm)			SGR (%)
	Initial	Final	NWG	Initial	Final	NLG	
Amur Carp	38.2±0.9	237.24±2.8	199.04	13.76±0.8	24.06±1.3	10.3	1.01
Catla	39.1±0.5	153.91±1.5	114.81	13.12±0.7	21.68±1.2	8.56	0.76
Rohu	37.2±0.6	130.16±1.1	92.96	13.18±0.6	20.89±1.1	7.71	0.69

Table 2: Somatic growth parameters of Amur carp and Silver barb in earthen ponds during study period

Species	Body weight(gm)			Body length (cm)		SGR (%)	
	Initial	Final	NWG	Initial	Final	NLG	
Amur Carp	39.6±0.8	223.91±1.9	184.31	13.61±0.9	23.14±1.2	9.53	0.96
Silver barb	40.2±0.7	230.17±1.8	189.97	13.89±0.8	23.91±1.3	10.02	0.97

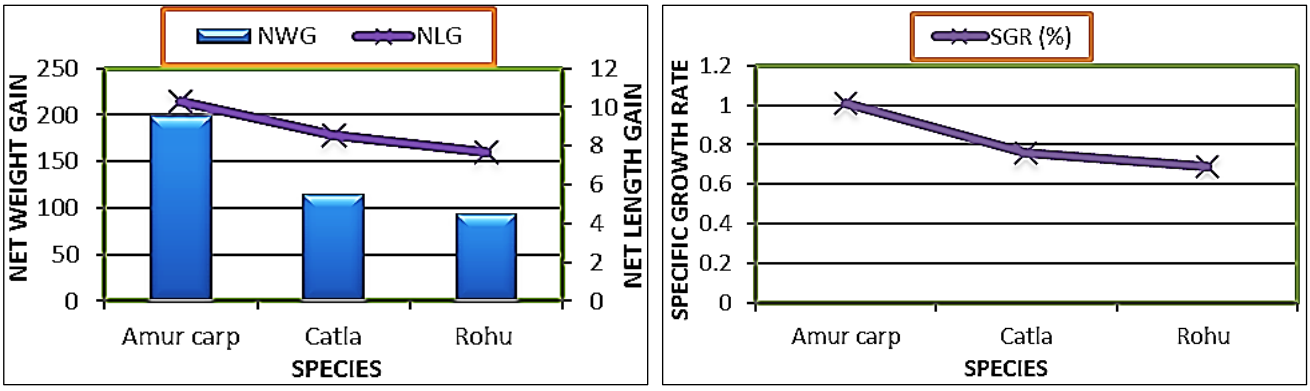

Fig 2: Comparative assessment of growth parameters in Amur carp, Catla and Rohu during study period

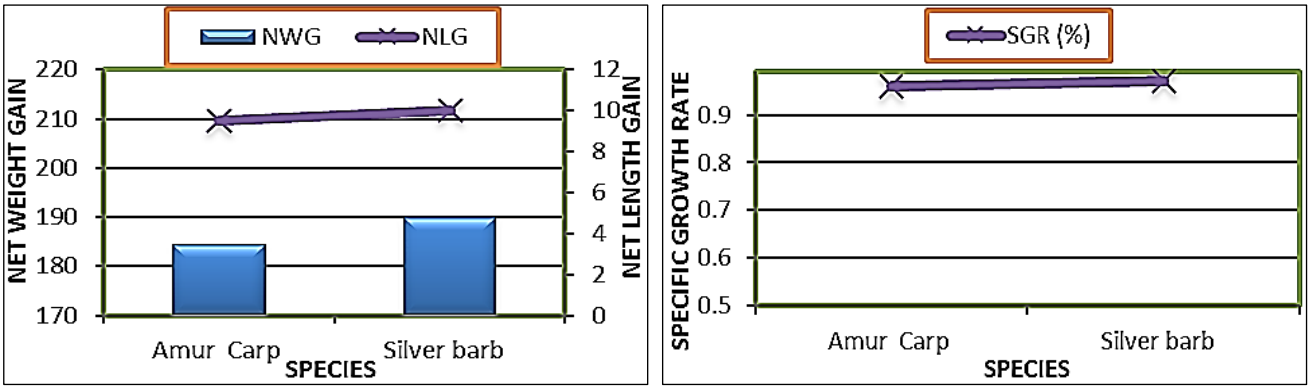

Fig 3: Comparative assessment of growth parameters in Amur carp and Silver barb during study period

Conclusion

Better somatic growth of Amur carp in culture with Silver barb reported as compared to Rohu and Catla. Higher yields generating higher profits may be obtained in the culture of Amur carp with Silver barb. The outcome of the present work demonstrated that Amur carp could be incorporated as an alternative species in combination with Silver barb in polyculture system and it may be improve fish production.

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