

# **Growth performance of common carp strains in highland aquaculture systems**

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## **1. Introduction**

Common carp is one of the most popular freshwater aquaculture species in Vietnam and is cultured in pond, cages and rice field for household consumption and income generation. A recent survey of 133 carp farmers indicated that pond and rice field production are the preferred form of culture systems with the pond culture the most common. Most farmers culture common carp with other fish species, both indigenous and exotic. In polyculture ponds, common carp is the predominate species making up 30.1% of the biomass (Austin et al., 2007).

The level of culture intensity for common carp varies from small scale extensive farming, with fish deriving all their nutrition from natural pond productivity, through semi-intensive farming using fertilization from organic material such as bran, agriculture by-products and household wastes to high intensive culture system with high stocking densities and the use of manufactured feeds. Semi-intensive culture systems are the most popular in Vietnam using ponds or a combination of ponds and rice field cultivation.

There are many factors that affect production and yield of farmed fish species, including seed (fry and fingerlings) quality, feed type and rate, fertilisation and pond management. Of these, seed quality, which is directly related to the genetic quality of the broodstock used to produce the fry and fingerlings, but which is not generally understood by farmers to be a potential issue affecting farm productivity.

In Vietnam there are many different local varieties of common carp that have been used by farmers but they usually have small size and low growth rate (Thien, 1983). Over recent times the Research Institute for Aquaculture No.I (RIA-I) has bred genetically improved common carp strains to enhance the productivity of small scale fish farms that utilise this species. This program has used crossbreeding and mass and family selection to produce genetically improved strains and is considered to have achieved an average increase of 5% in growth rate per generation over a number of generations (Thien and Thang, 1992). However, all the selective breeding and associated growth

trials have been conducted in research ponds, often without the availability of unselected lines as control populations for comparative studies.

As a consequence, on-farm growth trials of different strains were undertaken to allow for a more effective analysis of carp growth under environments directly relevant to small scale carp farmers and as a strategy to guide farmers uptake of genetically improved strains. This report presents on growth and survival of different common carp strains in highland small scale farmer ponds and rice fields in Yen Bai and Thai Nguyen provinces.

## **2. Experimental materials and methods**

### ***2.1. Experimental Design***

The on-farm trials was conducted to compare genetically improved carp strains and a local strain communally reared in farmer ponds and rice field systems, which reflects the proportion of these different farming systems in these two provinces. The experiment was conducted over a 12 months period from March 2006 to March 2007, which included spawning and fry rearing (March – May, 2006) and fingerling grow out (May 2006 to March 2007), which largely coincides with the normal carp farming culture cycle. The trials were conducted in pond & rice field systems owned by 20 households in each of the Thai Nguyen and Yen Bai provinces.

Fours common carp strains were used for growth trials. These included one strain (HP3) recently introduced Hungarian carp, Hungarian strain of the improved RIA-I Common carp (H-RIAI), an unselected Vietnamese strain (VN-USC) and a locally available strain (LOC).

Common carp breeding was undertaken at the National Broodstock Centre (Hai Duong). Broodstock of each experimental strain were induced to breed on the same day. Between 10 -12 families of fish were obtained from each strain. After 4-5 days hatching when larvae had reached 8-12 mm they were transferred to ponds and stocked at a rate of 100 larvae/m<sup>2</sup> and grown for a period of two months. Every effort was made to keep the conditions under which the fry and fingerlings of each strain were raised as similar as possible, especially in relation to stocking density and feeding regime. When the fingerlings had reached of 3-5g, they were tagged by using Coded Wire Tag (CWT).

The tagged fish were stocked into 40 ponds and rice field systems over a two day period. Communally stocked fish were in equal proportions with the exception of three ponds.

Each farm pond or rice field was stocked at a rate of 0.3 fish/m<sup>2</sup> and was classified as either “Low Feed” or “High Feed” based on the level of food inputs into the ponds. Pond or Rice field systems fed less than once per week were classified as low input systems and more than once per week as high input.

All experimental ponds and rice fish fields were managed by farmers. Fish in ponds and rice fields were fed by available foods from farmers’ households such as rice bran, corn and cassava. A log book was provided to each farmer to keep a record of food inputs into their experimental pond and other relevant information.

## ***2.2 Data collection and analysis***

Fish were harvesting by draining and by netting. Data from were collected as fish wet weight to the nearest 0.1 g. Fish were allocated to strain based on the identification of the position of the CWT using a detector. To compare growth between strains, fish weights were converted to daily growth rate (DGR) after first subtracting the mean fingerling weight for that strain.

All analyses were conducted using the Excel and SPSS software packages.

## **3. Results**

### ***3.1 Growth and survival of HP3 and LOC strains and effects of feed input***

Growth rate for the HP3 and LOC strains were compared in 18 farms which included both low and high feed input systems. The mean daily growth rate (DGR) of HP3 strain (0.48g/day) was 60% higher than that of local strain (LOC) (0.30g/day) (Table 1).

**Table 1.** Daily growth rate of HP3 and LOC strains in two type of feeding regimes

Strain	Low input	High input	Average DGR (g)
HP3	0.22 ± 0.02 <sup>a</sup>	1.13 ± 0.03 <sup>c</sup>	0.48
LOC	0.16 ± 0.02 <sup>b</sup>	0.79 ± 0.04 <sup>d</sup>	0.30

Table 1 gives the average daily growth rate for the 2 strains in each system and it can be seen there is only a 0.06g difference in average daily growth in low feed input systems compared with a 0.36 in high input system.

Survival rate of two strains are shown in Table 2. There is a significant difference in survival rate between low and high feed input farms but no significant difference between strains. The survival rate of HP3 and LOC strains is 24.77% and 22.76% respectively and it is 62% higher in High feed input ponds compared to Low feed input ponds.

**Table 2.** Survival rate (%) of HP3 and LOC strains in two types of feeding rates

Feed input	N	Mean	Std	Min	Max
Low	28	21.29 <sup>a</sup>	0.86	11.72	29.33
High	8	32.44 <sup>b</sup>	6.31	14.17	62.0

### 3.2 Growth rate and survival of HP3, H-RIAI and LOC strains

Growth data of three strains, HP3, H-RIAI and LOC were compared in 11 farms which included 10 low and 1 high feed input systems. Table 3 gives the average growth rate for the 3 strains. The daily growth rate of common carp strains in each farm was significantly different on the basis of Tukey's test with HP3>H-RIAI>LOC.

**Table 3.** Daily growth rate (g/day) of HP3, H-RIAI and LOC strains

Strain	Mean	Std	Min	Max
HP3	0.33 <sup>a</sup>	0.34	0.05	1.90
H-RIAI	0.26 <sup>b</sup>	0.27	0.04	1.51
LOC	0.23 <sup>c</sup>	0.23	0.02	1.05

### 3.3 Growth rate and survival of HP3, VN-USC and LOC Strains

Survival and Growth data from three strains, HP3, VN-USC and LOC were compared in 5 farms which included 4 low and 1 high feed input systems. Table 4 gives the survival and the average growth rate for the 3 strains. Each strain was significantly different on the basis of Tukey's test with growth rate of HP3>VN-USC>LOC.

Although survival rate of HP3 was the highest (20.57%) there had no significant difference comparing with other two strains (VN-USC = 17.98% and LOC = 18.49%)

**Table 4.** Survival and Daily growth rate of HP3, VN-USC and LOC strains

Strain	N	Survival (%)	DWR (g/day)
HP3	112	20.57	0.31 <sup>a</sup> ± 0.2
VN-USC	96	17.98	0.22 <sup>b</sup> ± 0.12
LOC	99	18.49	0.18 <sup>c</sup> ± 0.10

### **3.4 Growth and survival of HP3, H-RIAI, VN-USC and LOC in low feed inputs**

Growth data of all four strains, HP3, H-RIAI, VN-USC and LOC were compared in 3 low input farms in which they were raised communally. Table 5 gives the average growth rate for the 4 strains. Post hoc tests indicated significant differences among strains with HP3 > H-RIAI = VN-USC > LOC.

There are significant differences between fish survival rate among farms (P<0.05) with survival rate of fish in the farms ranged from 20.94 to 16.81 %. There was no significant differences in survival rate between common carp strains (P>0.05).

**Table 5.** Survival and daily weight rate of HP3, H-RIAI, VN-USC and LOC strains

Strain	N	Survival (%)	DWR (g)
HP3	71	16.81	0.26 <sup>a</sup> ± 0.08
H-RIAI	62	18.49	0.17 <sup>b</sup> ± 0.09
VN-USC	58	17.98	0.17 <sup>b</sup> ± 0.07
LOC	57	20.94	0.13 <sup>c</sup> ± 0.06

## **4. Conclusion and Recommendations**

Significant differences in growth rate of common carp strains were found This is the first on-farm growth trial to report difference in growth between strains of common carp. Specifically the overall findings were the growth rate of the HP3 strain was superior to the H-RIAI and VN-USC strains, which in turn were superior to the local strain (LOC).

The significance of this difference in growth performance was dependent on the level of feed input into the culture system. In low input systems the average differences between the best and worst strains was a growth rate of 0.06 grams per day, where as in high input systems the average difference in growth rate was 0.34 grams per day.

Very large difference in growth, survival and biomass production were apparent between farms. A significant factor explaining these differences can be attributed to feed input but it is likely that other environmental and husbandry aspects contribute to these very substantial differences.

Research on the development of genetically improved common carp strains should be continued as there is clear evidence that these strains are superior under the conditions of culture compared to local and wild strains.

Research on the effective dissemination of these strains is required and the possibility that a form of guarantee or certification can be provided to farmers by research stations and hatcheries to authenticate that fish being purchased are pure stocks of genetically improved lines.

Bioeconomic research is required to determine the cost benefit of using genetically improved strains and investing in more intensive farming strategies as there may be little value in farmers with low production systems purchasing genetically improve carp stocks as the extra expense of buying genetically improved fingerlings is unlikely to translate into elevated production and income.

## **Acknowledgement**

Many people contributed to the success of the on-farm trail to compare growth performance of common carp strains conducted in farmers' ponds and rice fields in Thai Nguyen and Yen Bai province as part of CARD project 002/04VIE. The project was given significant support from the Provincial Fisheries Centers of Thai Nguyen and Yen Bai. The efforts and assistance of the 40 common carp farmers who participated in these trials is gratefully acknowledged.

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