

**Results of Mass Selection of Crucian Carp
Based on Female Crucian Carp Size:
Fingerling to Market Growth Performance**

Results of ASA/China 2002 Feeding Trial 35-02-106

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ABSTRACT

The performance of offspring of large and average size female crucian carp brooders was evaluated from fingerling to market stages in the final year of a long-term series of on-farm trials to improve crucian carp growth performance. Select “large” and “average” female fish were segregated at the end of the 2000 fish production season and mated with Xinguo red common carp in the spring of 2001. Offspring produced in 2001 were cultured from fry to fingerling stages as the first step in assessing the potential for using on-farm mass selection as a means to improve crucian carp growth performance. In 2002, the same offspring groups were cultured from fingerling to market size to complete the mass selection assessment. Crucian carp offspring of both mass selection groups were cultured in ponds in 2002 for 183 days using the ASA 80:20 pond production and extruded, soy-based 32/6 feed. Fish in each group were fed to their own satiation level to allow expression of the natural genetic growth potential of each population. Offspring from the “average” female crucian carp breeding population grew from 42 g to 351 g with an average FCR of 1.42:1. Offspring from the “large” female crucian carp breeding population grew from 57 g to 393 g with an average FCR of 1.44. Mass selection based on female crucian carp body weight resulted in a 12% increase in size of offspring after 18 months of growth, and was significantly different ($P < 0.05$). There was no significant difference in feed conversion or fish survival between the two groups ($P > 0.05$). While growth performance between the two fish groups was significantly different, net income and return on investment at harvest were not significantly different. While mass selection improved fish size by 12%, the effect on farm income was negligible. Since both fish groups performed well and reached a market size ≥ 350 g, there was no advantage to the mass selection program with this stock of fish.

INTRODUCTION

The American Soybean Association (ASA), in cooperation with Tai Xing Fish Stock Farm and the Jiangsu Provincial Fisheries Extension Center, conducted a feeding trial with crucian carp to determine if mass selection based on female fish body weight could improve fish growth performance. This was the fifth year of a five-year trial series to quantify growth performance of a select strain of crucian carp using the ASA 80:20 pond production model and soy-based aquafeeds. Year one (1997) of this trial series compared fry to fingerling growth performance of three strains of crucian carp from fish farms in the lower Yangtze River area. The Tai Xing strain was selected as the best performing strain for use in the longer term ASA trial series. Year

two (1998) of the trial series quantified density-dependent fry to fingerling growth performance of the Tai Xing strain crucian carp. Year three (1999) of the trial series quantified fingerling to market growth performance of three fingerling size groups produced in the 1998 trial. Year four (2001) and year five (2002) trials compared fry to fingerling and fingerling to market growth performance of crucian carp produced by breeding mass selected large and randomly selected average size female crucian carp of the Tai Xing strain. Evaluation of mass selection was based on the change in fish body weight from the summer flower stage to the end of the second year production cycle, i.e. weight gain from approximately June 2001 to November 2002. This paper reports the results of the 2002 trial that evaluated crucian carp fingerling to market growth performance and final assessment of the mass selection effort.

MATERIALS AND METHODS

Six ponds of average size 2.0-mu at the Taixing Fish Stock Farm in Taixing, Jiangsu Province, were used for the feeding trial. Pond water depth averaged approximately 1.5 m. All ponds were equipped with water exchange and stand-by aeration.

Fish were Tai Xing strain crucian carp. Approximately 1,000 two-year old Tai Xing strain female crucian carp that were grown using ASA feed-based technologies at the Tai Xing Fish Stock Farm were pooled for mass selection at the end of the 2000 production season. The 100 largest fish and 100 average fish were selected from these pooled fish for breeding, using female fish body weight as the selection performance trait. The selected “large” and “average” female fish were kept in separate ponds and mated with Xinguo red common carp in the spring of 2001. Newly hatched fry of the same age from the large and average size female spawning groups were stocked in fertilized ponds and grown to approximately 0.4 g (summer flower stage) prior to stocking in the trial ponds. At size 0.4 g, 20,000 fish were randomly selected from each of the two test groups. Fish from each group were stocked in three randomly selected ponds at a density of 3,000 crucian carp fry per mu, together with 1,000 silver carp fry per mu, and grown to fingerling size using a two-phase feeding regime with the ASA 41/11 and 36/7 soy-based feeds. At the end of the fingerling production season, fish from each group were segregated and over-wintered for grow-out to market size in 2002.

In 2002, 5,000 fingerlings were randomly selected from each of the over-wintered populations for the fingerling to market growout trial. Randomly selected fish from each select population were stocked in three randomly selected ponds at a density of 800 fish per mu, together with 100 silver carp fingerlings per mu. Fish in all six ponds were cultured using the ASA 80:20 feed-based production model.

Crucian carp from the large and average test populations were fed to satiation twice daily, with fish in the three ponds of each treatment being fed identically as replicates of that treatment. Fish in the two treatment groups (large select offspring and average select offspring) were fed to their own satiation level to allow expression of the natural genetic growth potential of each population. Crucian carp in the three replicate ponds of each treatment group were fed identically at each feeding.

Crucian carp in all ponds were sampled once per month on approximately the same date each month to monitor growth performance. At the conclusion of the trial, the ponds were drained and the crucian and silver carp in each pond counted and weighed to determine average fish

weight, gross and net production, feed conversion ratio (FCR) and survival. Production input costs were recorded throughout the trial and net income and ROI calculated at the end of the trial.

RESULTS

Crucian carp were fed a total of 183 days between 8 May and 7 November 2002. Large select fish grew from 57 g to an average weight of 393g during this feeding period, with gross production of 392.7 kg/mu of crucian carp and 34.6 kg/mu of silver carp (Figure 1; Table 2). Average select fish grew from 42 g to 351 g, with gross production of 351.1 kg/mu of crucian carp and 44.9 kg/mu of silver carp (Figure 1; Table 2). Average harvest fish weight of the large select fish was 12% larger than the harvest weight of the average select crucian carp group, and was significantly different ($P<0.05$).

Average survival rates for the large and average select crucian carp populations were 93.5% and 94.3%, respectively, and were not significantly different ($P>0.05$). Average feed conversion rates (FCR) for the large and average select crucian carp populations with the 32/6 soymeal-based feed were 1.44:1 and 1.42:1, respectively. FCR was not significantly different ($P>0.05$). Average feed cost per kilogram of fish growth was RMB 4.39 for the large select fish and RMB 4.33 for the average select fish.

Net economic return averaged RMB 322.7 per mu for the large select fish and RMB 304.1 for the average select fish, at market prices of RMB 9/kg for crucian carp and RMB 3.0/kg for silver carp (Table 2). ROI averaged 13.3% and 13.8%, respectively, for the large and average crucian carp (Table 2). Net economic return and ROI were not significantly different ($P>0.05$).

SUMMARY AND CONCLUSIONS

Production of crucian carp of both the large and average select groups was good with the ASA 80:20 pond technology and soy-based feeds. Average harvest market weight of both fish groups was >350 g. The initial goal of this trial series, begun in 1997, was to develop a feed-based production strategy that would consistently produce crucian carp of size ≥ 250 g. This goal was exceeded by 40% using the ASA 80:20 technology and combination of soy-based fry, fingerling and growout feeds.

Mass selection of crucian carp based on female body size yielded a net increase in harvest fish size of 12% from a single round of selection. However, while mass selection significantly improved harvest fish size, the net improvement in farm income was only RMB 18.65, and was not significant. Since both fish groups performed well and reached a market size ≥ 350 g, there was no advantage to the single mass selection effort with this stock of fish. Fish farmers are recommended to adopt the 80:20 production technology and soy-based feeds to improve crucian carp performance, but random selection of female brooders appears to yield as good an economic return as mass selection based on female crucian carp size.

ACKNOWLEDGEMENTS

ASA gratefully acknowledges the Taixing Fish Stock Farm, the Jiangsu Provincial Fisheries Extension Center, and the China National Fisheries Technology Extension Center for their assistance and support for this aquaculture trial series.

Chinese Currency and Production Unit Conversions:

RMB 8.26 = US\$1.00
15 mu = 1.0 hectare (ha)
kg/mu x 15 = kg/ha
1.0 kg = 2.2 lb
6 mu = 1.0 acre (ac)
kg/mu x 13.2 = lb/ac

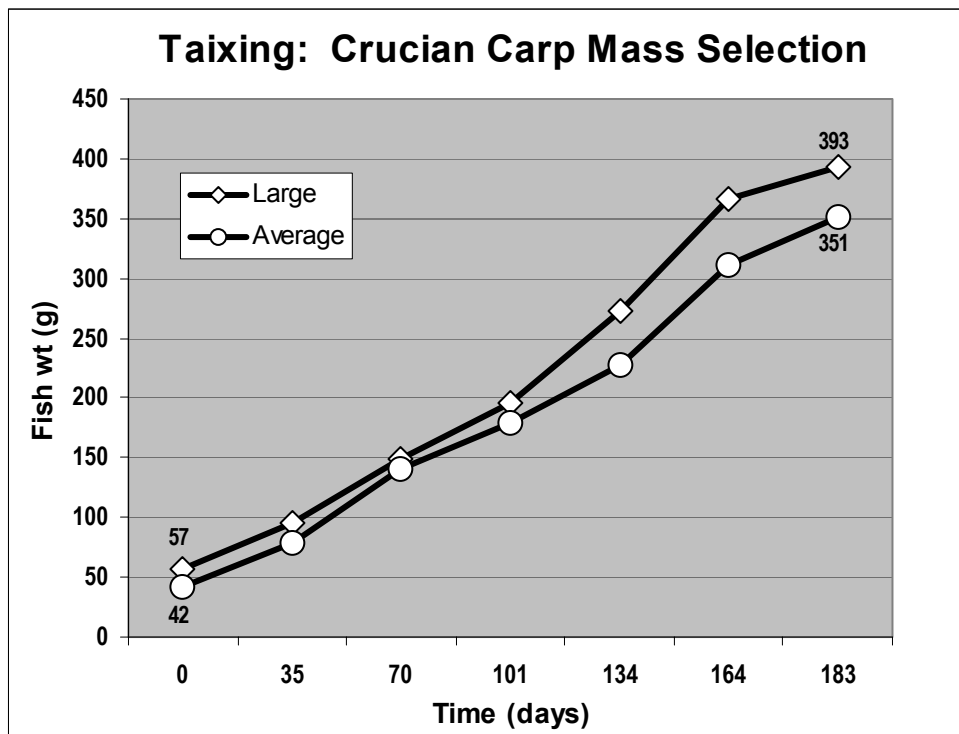


FIGURE 1. Growth curves for large and average select crucian carp produced in ponds with an extruded, soymeal-based aquafeed. Large select crucian carp were 12% larger at harvest than average select fish. Average feed conversions (FCR) were 1.44:1 and 1.42:1 for the large and average fish groups, respectively. Average feed cost per kilogram of fish growth with the soy-based, extruded feed was RMB 4.36.

Table 1. Formula for the ASA 32/6, soymeal-based growout feed used in the 2002 crucian carp mass selection feeding trial in Taixing, Jiangsu Province, China. Cargill feed mill produced the feed in extruded, floating pellet form.

Ingredient	32/6 Growout Feed ¹
Soybean meal 47.5	52.8
Wheat, SWW	23.6
Wheat middlings	10.0
Corn gluten meal 60%	6.0
Fish oil	3.53
Soy lecithin	1.00
Ca phosphate mono	2.70
Vit PMX Roche 2118	0.10
Min PMX F-1	0.25
Ethoxyquin	0.02
Total	100.00

¹The numerical component of the feed description refers to the percentage of protein and lipid, respectively, in the ration, i.e. 32/6 indicates 32% crude protein and 6% crude lipid.

Table 2. Results of the 2002 ASA aquaculture trial in Taixing that evaluated fingerling to market pond growth performance of large and average select crucian carp offspring from mass selected female crucian carp brooders using the ASA 80:20 production model and soymeal-based growout feed.

Pond No.	CrC ¹ stocking size (g)	Stocking rate (CrC/mu)	No. days fed	Harvest wt. (g)		P _G ³ (kg/mu)		Survival (%)		FCR	Net (RMB/mu)	ROI (%)
				CrC	SiC ²	CrC	SiC	CrC	SiC			
<u>Large Select</u>												
1	57.1	800	183	401.1	368.6	297.4	35.2	92.7	95.5	1.42	359.3	14.8
2	57.1	800	183	379.5	359.8	287.3	34.0	94.6	94.5	1.48	264.3	10.9
3	57.1	800	183	397.4	357.5	296.1	34.5	93.1	96.5	1.43	344.6	14.2
Mean	57.1	800	183	392.7	362.0	293.6	34.6	93.5	95.5	1.44	322.7	13.3
<u>Average Select</u>												
1	42.1	800	183	348.6	471.1	263.9	44.1	94.6	93.5	1.42	293.8	13.3
2	42.1	800	183	354.4	467.9	266.5	44.4	94.0	95.0	1.40	318.3	14.4
3	42.1	800	183	350.2	473.3	263.9	46.2	94.2	97.5	1.42	300.1	13.6
Mean	42.1	800	183	351.1	470.8	264.8	44.9	94.3	95.3	1.42	304.1	13.8

¹CrC = Crucian carp

²SiC = Silver carp

³P_G = Gross Production