

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

Results of ASA/China 2001 Feeding Trials 35-01-09

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ABSTRACT

The performance of offspring of large and average size female crucian carp brooders was evaluated 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. Selected “large” and “average” female fish were segregated at the end of the 2000 fish production season and mated with Xingguo 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) for the trial. Crucian carp offspring of both mass selection groups were cultured in ponds for 150 days using the ASA 80:20 pond production and soy-based fry and fingerling feeds. 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 0.36 g to 48.2 g with an average FCR of 1.20:1 (Table 2). Offspring from the “large” female crucian carp breeding population grew from 0.36 g to 59.6 g with an average FCR of 1.14 (Table 2). Fish growth was significantly different ($P<0.05$) for the two treatment groups, with fish within the “large” select group weighing 23.6% more than fish within the “average” group. FCR was not significantly different ($P>0.05$) for the two groups. Average survival for crucian carp was 96.3% for the “average” group fish and 95.7% for the “large” group fish. Survival rates for the two fish groups were not significantly different ($P>0.05$) (Table 2). The trial will be continued in 2002 to determine whether performance gains are carried through to market size 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 fourth 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 are comparing 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 will be 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 2001 trial that evaluated performance of the fry to fingerling component of the mass selection evaluation. The fingerlings will be cultured to market size in a 2002 ASA trial to complete the mass selection assessment.

MATERIALS AND METHODS

Six ponds of size 2.0 mu each at the Tai Xing Fish Stock Farm were used for the trial. Pond water was supplied from a canal to an average pond water depth of 1.2 m. All ponds were equipped with water exchange and stand-by aeration.

Fish were Tai Xing strain crucian carp. A minimum of 1,000 two-year old Tai Xing strain female crucian carp that were grown using 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.

A two-phase feeding regime was used to culture the crucian carp fry to fingerling size. Crucian carp of both groups were fed the ASA 41/11 fry feed in crumble form from fish size 0.4 g to fish size 3 g (5 cm)(Table 1). Crumble feed sizes were 0.5 mm (#1 crumble) for 2-3 cm fry and 1.0 mm (#2 crumble) for 3-5 cm fry. At fish size 5 cm (3 g), the crucian carp were weaned over a 5-day period to the ASA 36/7 fingerling feed, fed in extruded, floating pellet form (Table 1). Initial extruded pellet size was 1.5 mm. Feed pellet size was increased as the fish grew so that the feed pellet size was maintained at approximately the maximum that all fish in each treatment population could consume. The 41/11 fry and 36/7 fingerling feeds for the trial were formulated by ASA and produced by Fwusow Group at their aquafeed mill in Xiamen, Fujian Province.

Crucian carp from the large and average test populations were fed identically until fully weaned onto 36/7 extruded pellets. Thereafter, fish 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 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 150 days between 3 June and 1 November 2001. Offspring from the “average” female crucian carp breeding population grew from 0.36 g to 48.2 g with an average FCR of 1.20:1 (Table 2). Offspring from the “large” female crucian carp breeding population grew from 0.36 g to 59.6 g with an average FCR of 1.14 (Table 2). Fish growth was significantly different ($P < 0.05$) for the two treatment groups, with fish within the “large” select group weighing 23.6% more than fish within the “average” group. FCR was not significantly different ($P > 0.05$) for the two groups. Average survival for crucian carp was 96.3% for the “average” group fish and 95.7% for the “large” group fish. Survival rates for the two fish groups were not significantly different ($P > 0.05$) (Table 2).

Gross production averaged 139.3 kg/mu (2,090 kg/ha) for the “average” treatment fish population, and 171.2 kg/mu (2,568 kg/ha) for the “large” treatment fish population (Table 2). Silver carp production averaged 93.8 kg/mu in the “average” group ponds, and 93.5 kg/mu in the “large” group ponds (Table 2).

Net economic return averaged RMB 249.50 per mu for the three “average” group ponds, and RMB 447360 for the three “large” group ponds. Return on investment averaged 16.4% and 27.3% for the “average” and “large” groups, respectively. Economic return and ROI were both significantly higher ($P < 0.05$) for the “large” select group.

SUMMARY AND CONCLUSIONS

The results of this trial represent the first phase of a two-year production trial to assess the benefits of mass selection of female crucian carp based on fish body weight at the end of the second year of culture. Results from this trial show a 23.6% gain in growth performance from offspring of large select females during the fry to fingerling production phase when cultured using the ASA 80:20 production model and soy-based aquafeeds. The average survival rate in replicate ponds for the large select fish exceeded 93%, and the low FCR of 1.14:1 indicated good conversion efficiency of soy-based feeds. The trial will be continued in 2002 to determine whether performance gains are carried through to market size fish.

ACKNOWLEDGEMENTS

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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

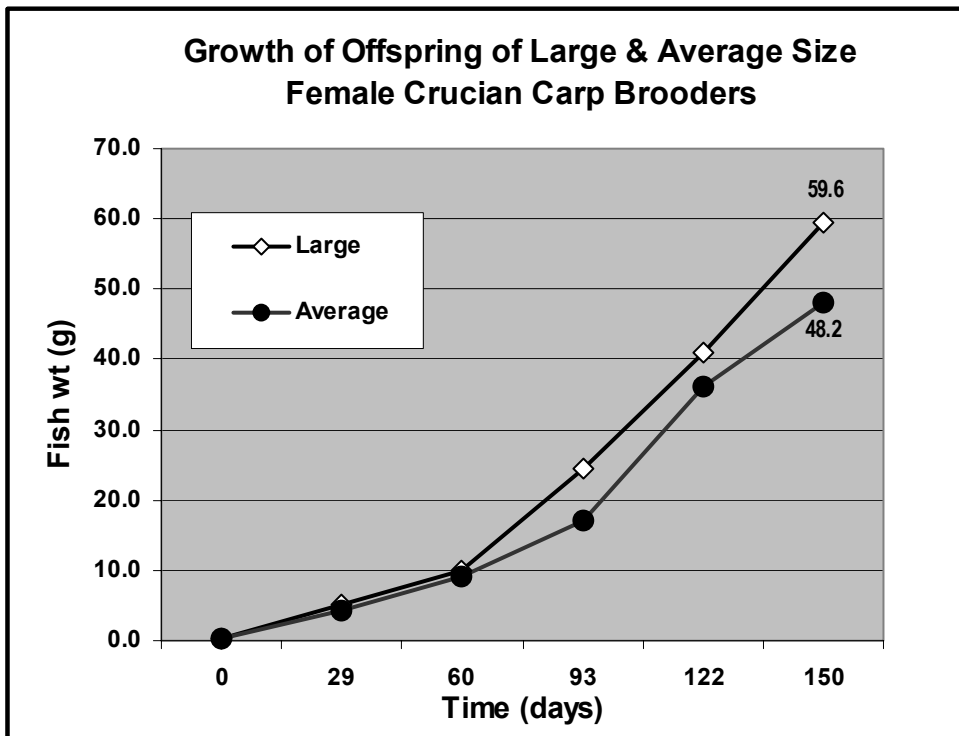


FIGURE 1. Growth curves show the performance of offspring of large- select and average-size female crucian carp brooders from the fry to fingerling stages. The production curves represent first year performance of a two-year production trial to determine the amount of gain that can be obtained through an on-farm, mass selection program. Female crucian carp brooders were selected based on fish body weight at the end of the second year of culture, and segregated and bred as “large” and “average” size brood stock populations. Offspring of large select female fish exhibited a 23.6% gain in growth during the fry to fingerling production phase evaluated in this trial.

Table 1. Formula for the ASA 41/11, soymeal-based fry feed used in the 2001 crucian carp mass selection field trial conducted at the Tai Xing Fish Stock Farm in Tai, Xing, Jiangsu Province, China. The feed was fed in crumble form to fish from size 0.4 g to 3.0 g.

Ingredient	41/11 Fry Feed ¹
Soybean meal 47.5	46.3
Corn gluten meal 60%	15.0
Fishmeal, Anchovy 65/10	14.0
Wheat, SWW	13.0
Fish oil	4.03
Soy oil	4.00
Soy lecithin	1.50
Ca phosphate mono	1.70
Vit PMX Roche 2118	0.20
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 fat, respectively, in the ration, i.e. 41/11 indicates 41% crude protein and 11% crude fat.

Table 2. Formula for the ASA 36/7, soymeal-based fingerling feed used in the 2001 crucian carp mass selection field trial conducted at the Tai Xing Fish Stock Farm in Tai, Xing, Jiangsu Province, China. The feed was fed in extruded, floating pellet form to fish from size 3.0 g.

Ingredient	36/7 Fingerling Feed ¹
Soybean meal 47.5	46.3
Wheat, SWW	19.0
Corn gluten meal 60%	10.0
Fishmeal, Anchovy 65/10	8.0
Wheat middlings 15%	8.0
Fish oil	4.58
Soy lecithin	1.50
Ca phosphate mono	2.20
Vit PMX Roche 2118	0.15
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 fat, respectively, in the ration, i.e. 36/7 indicates 36% crude protein and 7% crude fat.

TABLE 2. Results of the 2001 ASA crucian carp mass selection trial conducted at the Tai Xing Fish Stock Farm in Tai Xing, Jiangsu Province. Offspring of two-year old, large-select female crucian carp exhibited 23.6% greater growth performance than offspring of two-year old, average-size female crucian carp. Both large-select and average fish groups exhibited high survival and good conversion efficiency with soy-based aquafeeds.

Fish group	CrC ¹ stocking size (g)	Stocking rate (fish/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			
Average	0.36	3,000	150	48.4	87	139.7	87.1	96.3	97.1	1.19	226	14.9
Average	0.36	3,000	150	50.8	102	145.3	101.7	95.4	97.2	1.15	340	22.4
<u>Average</u>	<u>0.36</u>	<u>3,000</u>	<u>150</u>	<u>45.5</u>	<u>93</u>	<u>133.0</u>	<u>92.7</u>	<u>97.4</u>	<u>95.8</u>	<u>1.25</u>	<u>189</u>	<u>12.0</u>
	0.36	3,000	150	48.2	94	139.3	93.8	96.3	96.7	1.20	249	16.4

Large	0.36	3,000	150	61.2	88	175.9	84.8	95.8	96.4	1.11	460	28.0
Large	0.36	3,000	150	58.0	110	167.8	104.8	96.3	95.2	1.16	458	28.0
<u>Large</u>	<u>0.36</u>	<u>3,000</u>	<u>150</u>	<u>59.7</u>	<u>94</u>	<u>170.0</u>	<u>90.8</u>	<u>95.0</u>	<u>96.3</u>	<u>1.15</u>	<u>425</u>	<u>26.0</u>
	0.36	3,000	150	59.6	97	171.2	93.5	95.7	96.0	1.14	448	27.3

¹CrC = Crucian Carp

²SiC = Silver Carp

³P_G = Gross Production