

**Key Words:** Common carp, soy-based feed, LVHD cage technology, China, soybean meal, soy hulls

## **LVHD Cage Culture of Grass Carp with Soy-Based Feed in the Xintian Reservoir, Chongqing**

### **Results of ASA-IM/China 2010 Feeding Demo 35-10-513**

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#### **INTRODUCTION**

A feeding demonstration was jointly conducted by the American Soybean Association International Marketing (ASA-IM) program and the Wanzhou District Fishery Association, Chongqing, China, to demonstrate the production performance of grass carp in Low Volume High Density (LVHD) cages with the ASA-IM 32/3<sup>1</sup> soymeal-based growout feed. The objective of the LVHD grass carp feeding demonstration was to demonstrate the production performance of grass carp with the ASA-IM formulated 32/3 extruded soybased feed without any supplementary grass in the Xintian Reservoir, Wanzhou District, Chongqing.

#### **PROTOCOLS**

Three, 4-m<sup>3</sup> LVHD cages, 2-m square x 1-m deep, were constructed and deployed in Wanzhou Xintian Reservoir, Chongqing, for the feeding demonstration. The cages were constructed of nylon netting and outfitted with opaque covers to reduce light and external motion stress. A feed enclosure approximately 1-m square in size was installed inside each cage. The feed enclosure extended sufficiently above and below the water line to contain extruded, floating feed pellets. Cage placement was in a single row, with 2-m spacing between cages to ensure adequate water exchange to each cage.

<sup>1</sup>The numerical component of the feed description refers to the percentage of protein and fat, respectively, in the ration, i.e. 32/3 indicates 32% crude protein and 3% crude fat.

Grass carp fingerlings were stocked in the three demonstration cages at a density of 175 fish per m<sup>3</sup> (700 fish per cage). The average size of grass carp at stocking was 116 g. The grass carp fingerlings for the demonstration were produced locally in the traditional big cages.

The LVHD grass carp feeding demonstration commenced on 6 May 2010. Grass carp were fed to 90% satiation level twice daily for 160 days with the ASA-IM 32/3 soymeal based feed (Tables 1-3). The grass carp growout feed was formulated to contain approximately 20% less energy and 5% more fiber than the standard ASA-IM carp 32/6 growout feed. The grass carp feed is an all-plant protein ration that uses soybean meal and soy hulls as the primary suppliers of protein and fiber in the diet, respectively. The energy level of the feed is kept low by maintaining fat at 3% in the diet. This lower energy level helps to reduce the cost of the feed. All feed was fed in extruded, floating pellet form. The feed was formulated by ASA-IM and manufactured by the Techbank Feed Mill in Yuyao, Zhejiang Province, China.

The demonstration cages were harvested on 13 October 2010. All fish from each of the demonstration cages were weighed to obtain data on gross and net production and feed conversion efficiency for each cage. Sub-samples of fish were obtained from each cage to determine estimated fish survival and average fish weights. Water quality data was recorded throughout the demonstration, in particular to compare water temperature and visibility in the demonstration reservoir to the same parameters observed in the Three Gorges Reservoir during earlier demonstrations. Data on production input costs was recorded to determine the economic value of the 32/3 feed. Net economic return and return on investment (ROI) were calculated after harvest from production input and fish harvest records.

## RESULTS

Grass carp grew from 116 g to an average weight of 592 g per fish during the 160-day feeding period (Figure 1, Table 4). Grass carp biomass at harvest averaged 98 kg/m<sup>3</sup> (392 kg/cage) for the two demonstration cages because one demonstration cage was lost in a severe storm event during the monsoon season. Average survival rate for the grass carp was 94.9%. Feed conversion ratio (FCR) for grass carp with the 32/3 soymeal based feed averaged 1.85:1 for the two demonstration cages. Harvested fish had good color and body conformation and were uniform in size.

The demonstration yielded an average net economic return to the cooperator of RMB 392 per cage at a market price of RMB 14/kg for grass carp (Table 4). Return on investment (ROI) for the two demonstration cages averaged 27%.

## SUMMARY AND CONCLUSIONS

It was the first time for local farmers in the region to use extruded feed to culture grass carp without any supplementary grass. Grass carp growth in LVHD cages in the environmental conditions in Xintian Reservoir was less than is normally obtained in pond environments, but was acceptable for local market conditions. Grass carp growth, FCR and economic return were significantly better with the extruded soy-based feed than with the traditional combination of a local sinking feed and cut grass.

Average water temperature in Xintian Reservoir during the demonstration period was 5°-6°C higher than in previous demonstrations in the Three Gorges Reservoir, allowing significantly better fish growth performance than can be obtained in the Three Gorges Reservoir.

Although grass carp growth in LVHD cages in this demonstration was poorer than in earlier cage trials in southern China, the economic return obtained in this demonstration indicates there is good potential for LVHD cage culture of grass carp and other Chinese carps using high quality soy-based feed in the many hill reservoirs in this region.

There were no fish distress or disease incidences observed during the demonstration, although one demonstration cage was lost during a severe storm event. No drugs or chemicals were used in the demonstration, allowing the harvest of high quality, uncontaminated fish that met the standard for a “green” product.

## **ACKNOWLEDGEMENTS**

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### **Chinese Currency and Production Unit Conversions:**

RMB 6.50 = 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

Table 1. Formula for the ASA-IM 32/3, all-plant protein, soymeal-based feed used in the 2010 LVHD grass carp feeding demo at Xintian Reservoir, Wanzhou District, Chongqing. The feed is a low energy and high fiber feed fed in extruded, floating form. The demo feed was produced by Ningbo Techbank Feed Company, Zhejiang Province.

Ingredients	Percent of total
<i>Soybean Meal 46%</i>	<i>45.00</i>
<i>Wheat Midds</i>	<i>30.00</i>
Wheat Flour	9.00
Soy Hulls	5.00
Corn Gluten Meal 60%	5.00
Blood Meal, spray dried	2.00
Ca Phosphate Mono 21%P	1.90
Fish Oil	1.00
Vit PMX-F2	0.50
Min PMX F-1	0.25
DL-Methionie 99%	0.15
Choline Chloride 50%	0.13
Stay C 35%	0.03
Antioxidant	0.02
Mycotoxin Binder	0.01
Mild Inhibitor	0.01
TOTAL	100.00

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Table 2. Calculated nutritional profile of the ASA-IM 32/3, soy-based feed used in the 2010 LVHD grass carp feeding demo at Xintian Reservoir, Chongqing, China

Nutrient	Amount	Unit
DE Fish	2319.60	kcal/kg
NFE	40.90	%
Starch	19.36	%
*Protein	32.05	%
Protein, dig.	30.00	%
Fish Protein	0.00	%
Soy Protein	21.19	%
*Fat	3.04	%
W 3	0.39	%
W 6	0.98	%
Fiber	6.22	%
*Ash	6.38	%
Calcium	0.50	%
Phos Avail	0.55	%
Iron	515.63	%
Copper	34.26	%
Zinc	131.27	ppm
Selenium	0.83	ppm
Moisture	9.89	ppm
Vitamin C	105.00	ppm
Choline	2485.04	%
Ethoxyquin	134.50	mg/kg
Arginine	2.01	mg/kg
Lysine	1.81	mg/kg
Methionine	0.60	%
Meth+Cyst	1.07	%
Threonine	1.25	%
Tryptophan	0.38	%

Table 3. Vitamin and mineral premix formulations for the ASA-IM 32/3, soymeal-based feed used in the 2010 LVHD grass carp feeding demo at the Xintian Reservoir, Wanzhou District, Chongqing, China. Quantities of vitamins and minerals are per kilogram of premix. Both premixes were produced at the Chengdu Phoenix Feed Company, Sichuan Province.

Ingredient	Unit	Amount
<u><i>Vitamin Premix F-2</i></u>		
<i>Vitamin A</i>	<i>IU/kg</i>	<i>1,200,000</i>
Vitamin D3	IU/kg	200,000
Vitamin E	IU/kg	20,000
Vitamin K	mg/kg	0
Vitamin C	mg/kg	0
Biotin	mg/kg	40
Choline	mg/kg	0
Folic Acid	mg/kg	1,800
Inositol	mg/kg	0
Niacin	mg/kg	40,000
Pantothenate	mg/kg	20,000
Pyridoxine (B6)	mg/kg	5,000
Riboflavin (B2)	mg/kg	8,000
Thiamin (B1)	mg/kg	8,000
Vitamin B12	mcg/kg	2,000
Ethoxyquin	mg/kg	500
<u>Mineral Premix F-1</u>		
Iron	ppm	40,000
Manganese	ppm	10,000
Copper	ppm	4,000
Zinc	ppm	40,000
Iodine	ppm	1,800
Cobalt	ppm	20
Selenium	ppm	200

**Figure 1.** Growth curve for the grass carp produced in the ASA-IM LVHD cages at Xintian Reservoir, Wanzhou District, Chongqing, China. The Grass carp grew from 116 g to 592 g in 160 days with an average feed conversion ratio of 1.85:1.

Table 4. Results of the 2010 ASA-IM feeding demonstration in Xintian Reservoir, Chongqing, China, that demonstrated growth performance of grass carp in LVHD cages using the ASA-IM 32/3 soymeal based feed fed in extruded, floating pellet form.

Cage No.	Fish stocking size (g)	Stocking rate (fish/m <sup>3</sup> )	No. days fed	Harvest wt. (g)	Production (kg/m <sup>3</sup> )	Survival (%)	FCR	Net income (RMB/cage)	ROI (%)
1	116	175	160	550	93.8	97.4	1.95	947.9	22
2	116	175	160	634	102.6	92.4	1.75	1,406.6	32
Mean	116	175	160	592	98.2	94.9	1.85	1,177.3	27