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Feeding Trials Demonstrate Effectiveness of Soy-Based, High Protein Feed for Black Carp Production

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INTRODUCTION

Pond feeding trials conducted cooperatively by the American Soybean Association International Marketing (ASA-IM) program, the Heilongjiang Provincial Fishery Extension Center and the Shenyang Municipal Fishery Research Institute demonstrated the economic value of a soy-based, high protein diet for black carp. Feeding trials were conducted in 2006 in Heilongjiang and Liaoning Provinces to evaluate second and third year growth performance of black carp fed a soy-based, 36% crude protein feed and the resulting economic value to fish farmers in the northeastern region of China.

OPTIMAL DIET FOR BLACK CARP

Black carp fingerling to market pond production trials conducted in 2005 in Anhui and Heilongjiang Provinces yielded slow fish growth and variable FCR and economic return with the soy-based ASA-IM 32/6¹ feed. The ASA-IM 32/6 feed is the standard feed used for fingerling to market production of species such as common carp, crucian carp, tilapia and channel catfish, and typically yields rapid growth and high feed conversion efficiency. However, based on the variable results obtained in the 2005 trials with black carp fed the 32/6 feed, trial cooperators suggested increasing the protein level of the feed in subsequent trials to improve black carp growth and feed conversion.

Following this recommendation, two feeding trials were conducted in 2006 to test the higher protein ASA-IM 36/7 fingerling feed as a growout feed for second and third year black carp production. The ASA-IM 36/7 feed is normally used only for the production of fingerling fish up to approximately 50 g in weight, and has both higher crude protein and crude lipid levels than the 32/6 growout feed (Tables 1-3).

The 2006 trials with black carp were scheduled for 4-5 months duration, depending on weather and water temperature in each of the trial regions. Data on fish survival, gross

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

and net production, average fish weight, and feed conversion efficiency were obtained at harvest for both trials. All fish from each of the three test ponds in each trial were counted and weighed to obtain this data. Sub-samples of each species were taken in each pond to get estimated average fish weights for black and silver carp. Data on production input costs was recorded throughout each trial to determine the economic value of the higher protein feed.

2006 FEEDING TRIAL PROTOCOLS AND RESULTS

Shenyang Trial

The Shenyang trial evaluated second year black carp growth in ponds with the ASA-IM 36/7 feed. Black carp were stocked in three, 2.4-mu (0.16 ha) ponds at the Shenyang Municipal Fishery Research Institute Experimental Fish Farm at a density of 600 fish per mu (9,000/ha), together with 100 silver carp fingerlings per mu (1,500/ha). Average size of the black carp at stocking was 51 g. Black carp were stocked in the three trial ponds on 9 May 2006, and harvested on 25 September 2006. Black carp were fed to satiation twice daily for 131 days with the ASA-IM soy-based, 36/7 fingerling feed during this period. All feed was fed in extruded, floating pellet form. Pond management was based on the ASA-IM 80:20 model. Black carp in this trial had a target harvest weight of 500 g,

Black carp grew from 51 g to an average weight of 693 g per fish during the 131-day trial period (Table 4). Fish production at harvest averaged 395 kg/mu (5,925 kg/ha) for black carp and 93 kg/mu (1,395 kg/ha) for silver carp. The average survival rate for black carp was 95%. The feed conversion ratio (FCR) for black carp with the soy-based, high protein 36/7 feed averaged 1.32:1 for the three trial ponds.

The low FCR and rapid fish growth on the soy-based 36/7 feed yielded an average net economic return to the producer of RMB 1,280 per mu (\$2,430/ha) at market prices of RMB 9.0/kg (\$1.14/kg) for black carp and RMB 2.5/kg (\$0.32/kg) for silver carp. Return on investment (ROI) for the three demonstration ponds averaged 51.1%. ROI was calculated by dividing net income by total costs for each pond.

Harbin Trial

The Harbin trial evaluated third year black carp growth in ponds with the ASA-IM 36/7 feed. Fish for the 2006 trial were sub-market size black carp produced in the 2005 ASA-IM black carp feeding trial at the Heilongjiang Provincial Fisheries Extension Center Demonstration Fish Farm near Harbin. Black carp in the 2006 Harbin trial were stocked in three, 3.0-mu (0.2 ha) ponds at a density of 450 fish per mu (6,750/ha), together with 100 silver carp fingerlings per mu (1,500/ha). Average size of the black carp at stocking was 250 g. Black carp were stocked in the three trial ponds on 9 May 2006, and harvested on 20 September 2006. The black carp were fed to satiation twice daily with the ASA-IM soy-based, 36/7 fingerling feed for 129 days during this period. All feed was fed in extruded, floating pellet form. Pond management was based on the ASA-IM 80:20 model, but also included zero water exchange protocols to conserve water in this water deficit area. The target harvest weight for black carp in this trial was 1,000 g.

Black carp grew from 250 g to an average weight of 855 g per fish during the 129-day trial period (Table 5). Fish production averaged 368 kg/mu (5,520 kg/ha) for black carp and 51 kg/mu (765 kg/ha) for silver carp. The average survival rate for black carp was 95.7%. The feed conversion ratio (FCR) for black carp with the soy-based, high protein 36/7 feed averaged 1.08:1 for the three trial ponds.

The trial yielded an average net economic return of RMB 2,154 per mu (\$4,090/ha) at market prices of RMB 16/kg (\$2.02/kg) for black carp and RMB 4/kg (\$0.50/kg) for silver carp. Return on investment (ROI) for the three demonstration ponds averaged 54.7%.

SUMMARY AND CONCLUSIONS

Results from the two feeding trials conducted in 2006 indicate the higher protein 36/7 feed is an excellent feed for black carp production from fingerling to market stages. Second year fish in the Shenyang trial exhibited rapid growth with the soy-based 36/7 feed. The average weight of fish harvested from this trial exceeded the target market size of 500 g by 39% after 131 days of feeding.

The 36/7 feed proved to be efficient and economical for both second and third year production of black carp. Feed conversion efficiency was good, with FCR ranging from 1.08:1 to 1.32:1 with the high protein feed. Black carp growth and economic return were significantly better with the higher protein 36/7 feed than with the 32/6 feed tested in 2005 trials. Economic return was reported to be better for black carp fed the 36/7 feed than for most other species in the Harbin and Shenyang areas.

No drugs or chemicals were used in the ASA-IM black carp trials, allowing the harvest of high quality, uncontaminated fish that met the standard for a “green” product. Pond water quality remained good throughout the 2006 trials, with no observed surfacing of fish, and no reported incidences of fish disease. Harvested fish had a good body conformation and were well accepted in the market.

The ASA-IM zero water exchange technology tested in the Harbin trial was found to be technically and economically feasible for black carp culture when combined with the 80:20 model and soy-based feed. The zero water exchange technology was reported to significantly reduce energy costs.

Overall, the soy-based ASA-IM 36/7 feed proved to be a superior growout feed for black carp and demonstrated the feasibility of sustainable and economically viable feed-based production of black carp in the northeastern region of China.

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Table 1. Formula for the least-cost formulated ASA-IM 36/7, soy-based feed used in the 2006 black carp pond feeding trials in Shenyang, Liaoning Province, and Harbin, Heilongjiang Province, China. The 36/7 feed is a high protein feed typically used for fingerling production, but which proved to also be a superior growout feed for second and third year black carp production in ponds.

Ingredient	Percent of total
Soybean Meal 46%	43.50
Wheat Middlings 14%	14.00
Fish Meal 65/8	13.00
Wheat Flour 11%	12.00
Corn Gluten Meal 60%	5.00
DDGS 27/10	5.00
Fish Oil, Unspec.	2.50
Ca Phosphate Mono 21%	1.69
Soy Lecithin	1.50
Soy Oil	1.00
Vit PMX F-2	0.50
Min PMX F-1	0.25
Stay C 35%	0.03
Ethoxyquin, SQ mixture 6	0.02
Choline Chloride 60%	0.01
TOTAL	100.00

Table 2. Calculated nutritional profile of the ASA-IM 36/7, soy-based feed used in the 2006 black carp pond feeding trials in Shenyang, Liaoning Province, and Harbin, Heilongjiang Province, China.

Nutrient	Value, As Fed
DE Fish (extruded)	2871.61
Starch	17.98
Protein, crude	36.14
Protein, digestible	33.55
Fish Protein	8.45
Soy Protein	20.01
Fat	6.96
W-3 (omega 3 fatty acid)	1.02
W-6 (omega 6 fatty acid)	1.62
Fiber	3.22
Ash	6.86
Calcium	0.92
Phosphorus, available	0.70
Choline	2497.61
Vitamin C	105.00
Ethoxyquin	134.50
Arginine	2.19
Isoleucine	1.77
Lysine	2.12
Methionine	0.68
Methionine + Cystine	1.20

Table 3. Vitamin and mineral premix formulations for the ASA-IM 36/7, soy-based feed used in the 2006 black carp feeding trials. Quantities of vitamins and minerals are per kilogram of premix.

Ingredient	Unit	Amount
<u>Vitamin Premix F-2</u>		
Vitamin A	IU/kg	1,200,000
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

Table 4. Results of the 2006 ASA-IM aquaculture trial in Shenyang that demonstrated fingerling to market growth performance of black carp in ponds using the ASA 36/7 soy-based feed fed in extruded, floating pellet form.

Pond No.	BkC ¹ stocking size (g)	Stocking rate (fish/mu)	No. days fed	Harvest wt. (g)		P _G ³ (kg/mu)		Survival (%)		FCR	Net income (RMB/mu)	ROI (%)
				BkC	SiC ²	BkC	SiC	BkC	SiC			
1	51	600	131	770	945	432	95	93.5	100	1.19	1,618	64.6
2	51	600	131	605	1,210	350	121	96.5	100	1.49	950	37.9
3	51	600	131	705	645	402	65	95.0	100	1.29	1,272	50.8
Mean	51	600	131	693	933	395	93	95.0	100	1.32	1,280	51.1

¹BkC = Black Carp

²SiC = Silver Carp

³P_G = Gross Production

Table 5. Results of the 2006 ASA-IM aquaculture trial in Harbin that demonstrated third-year growth performance of black carp in ponds using the ASA 36/7 soy-based feed fed in extruded, floating pellet form.

Pond No.	BkC ¹ stocking size (g)	Stocking rate (fish/mu)	No. days fed	Harvest wt. (g)		P _G ³ (kg/mu)		Survival (%)		FCR	Net income (RMB/mu)	ROI (%)
				BkC	SiC ²	BkC	SiC	BkC	SiC			
1	250	450	129	857	563	370	52	96.0	92	1.07	2,196	55.8
2	250	450	129	865	557	370	51	95.1	91	1.07	2,190	55.6
3	250	450	129	841	541	364	50	96.0	92	1.10	2,077	52.7
Mean	250	450	129	855	554	368	51	95.7	92	1.08	2,154	54.7

¹BkC = Black Carp

²SiC = Silver Carp

³P_G = Gross Production