Key Words: Grass carp, soybean meal, soy hulls, 80:20 pond technology, extruded feed, sinking pellet, China

**Comparison of the Production Performance of Grass Carp fed an Extruded Soy-based Feed and a**

**Pelleted Sinking Feed**

Results of ASA-IM/China 2010 Feeding Demo U-35-10-514

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**Introduction**

A pond feeding demonstration was jointly conducted by the American Soybean Association International Marketing (ASA-IM) program, the Jiangsu Provincial Fishery Technology Extension Center, and the Pingwang State Fish Farm, Jiangsu Province, in collaboration with the Nanjing Institute of Environmental Science (NIES) to demonstrate the productivity, economic, and environmental advantages of the ASA-IM 80:20 pond technology with ASA-IM formulated extruded soybased feed in comparison to a local sinking feed. The feeding trial was conducted on the Demonstration Farm of Wujiang Aquaculture Co. Ltd., Jiangsu Province, China.

**PROTOCOLS**

Six, 6.0-mu (0.4-ha) ponds at the Demonstration Farm of Wujiang Aquaculture Co. Ltd., Suzhou City, Jiangsu Province were used for the comparison feeding demonstration. The six ponds were identically prepared and treated for the demonstration.

The demonstration fish were 75-g grass carp purchased from the market. Grass carp were stocked in the six demonstation ponds at a density of 500 fish per mu (7,500/ha), together with 100 silver carp per mu (1,500/ha) according to the ASA-IM 80:20 pond production model. Fish in all six demonstration ponds were of uniform size and age at stocking. Target market size for the grass carp was >1.0 kg per fish.

Grass carp in three of the ponds were fed to 90% satiation twice daily with the ASA-IM 32/3[[1]](#footnote-1) grass carp feed (Tables 1-3). This feed is a low energy, high fiber feed that is designed to closely mimic the natural food intake of grass carp. Soybean meal is used as the primary protein source in the feed, and soy hulls as a primary fiber source. All feed was fed in extruded, floating pellet form. The feed was produced by the Ningbo Techbank Feed Mill in Ningbo, Zhejiang Province, China, and least-cost formulated based on ASA-IM formulation specifications and with ASA-IM technical support.

Grass carp in the other three ponds were fed with a locally manufactured sinking pellet feed with a protein level of 28%. The local feed was fed twice daily based on the estimated biomass of the feed-taking species correlated with a locally developed feeding table. Fish in the three control ponds were fed the same amount of local feed at each feeding.

The comparison feeding demonstration was conducted over a 6.5-month period. At the end of the feeding demonstration, all ponds were drained and the fish from each pond harvested and weighed independently. Sub-samples of each species of fish were taken from each pond population to determine average fish weight for the species. Data on fish survival, gross and net production, average fish weight, and feed conversion efficiency were calculated for all ponds. Data on production input costs was recorded throughout the demonstration to determine the economic return from each pond and the average for the three ponds for each feed.

**RESULTS**

Grass carp in the Pingwang feeding demonstration were fed for 196 days between 10 May and 23 November 2010. Grass carp fed the ASA-IM 32/3 extruded soybased feed grew from 75 g to an average weight of 1,798 g, while grass carp fed the local sinking pellet grew from 75 g to an average weight of 877 g (Table 4, Figure 1). Average FCR with the two feeds was 1.56:1 with the 32/3 soybased feed and 3.17:1 with the local sinking feed (Table 4). There were significant differences in fish growth and FCR between the two feeds.

Fish biomass at harvest averaged 533 kg/mu (7,995 kg/ha) with the ASA-IM extruded soybased feed and 266 kg/mu (3,990 kg/ha) with the local sinking feed. The higher biomass production with the 32/3 soybased feed was the result of faster growth and larger fish size at harvest.

Survival rates for grass carp fed the 32/3 extruded soy-based feed and the local sinking pelleted feed were 60.2% and 61.1% respectively. There was no significant difference in survival between these two feed treatments. Net income and return to investment (ROI) for the three ponds with 32/3 extruded soybased feed averaged RMB 1,429/mu ($3,233/ha) and 26.2%, respectively, while the net income and return to investment (ROI) for the three ponds with the local sinking pelleted feed averaged RMB 504/mu ($1,140/ha) and -12%, respectively.

**SUMMARY AND CONCLUSIONS**

The ASA-IM 32/3 extruded soy-based feed significantly out-performed the local sinking feed in every aspect evaluated. Grass carp production with 32/3 soybased feed was 100% higher that with the local sinking feed. Average grass carp size at harvest was 105% larger in the ponds with 32/3 extruded soy-based feed than in the ponds with the local sinking feed.

FCR with the ASA-IM extruded soybased feed (1.56:1) was half that obtained with the sinking pelleted feed (3.17:1). As result, the average net income of the three ponds with the ASA-IM 32/3 soy-based feed (RMB 1,429) was 2.8 times higher than the three ponds with local sinking feed (RMB 504/mu).

In conclusion, the ASA-IM formulated 32/2 soy-based feed yielded rapid growth, a high economic return, and a sustainable harvest biomass of 8 mt/ha with the ASA-IM 80:20 technology. In comparison, the local sinking feed yielded a significant economic loss. The ASA-IM encourages the fish farming industry to adopt the extruded soybased feeds as a method to improve fish production, economic return and industry sustainability in China and elsewhere in the world.

**ACKNOWLEDGEMENTS**

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**Chinese Currency and Production Unit Conversions:**

RMB 6.60 = 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, soy-based feed used in the 2010 grass carp pond feeding demonstration conducted at the Wujiang Aquaculture Co. Ltd. Demonstration Farm in Jiangsu Province, China. The feed is a low energy and high fiber feed fed in extruded, floating form. The demonstration feed was produced by Ningbo Techbank Feed Company, Zhejiang Province.

 Ingredients Percent of total

 Soybean Meal 46% 45.00

 Wheat Midds 30.00

##  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 grass carp feeding demonstration conducted at the Wujiang Aquaculture Co. Ltd. Demo Farm, Jiangsu Province, 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, soybased feed used in the 2010 grass carp feeding demonstration at the Wujiang Aquaculture Co. Ltd. Demonstration Farm, Jiangsu Province, China. Quantities of vitamins and minerals are per kilogram of premix. Both premixes were produced by Chengdu Phoenix Feed Company, Sichuan Province.

 Ingredient Unit Amount

 Vitamin Premix F-2

 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

 Mineral Premix F-1

 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

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**Figure 1.** Growth curve for grass carp fed the ASA-IM formulated extruded soy-based feed and a local sinking pelleted feed. Grass carp fed the ASA-IM 32/3 extruded soy-based feed grew from 70 g to 1,798 g with an average FCR of 1.56:1,; while grass carp fed the local sinking feed grew from 75 g to 877 g with an average FCR of 3.17:1 in 196 days.

Table 4. Results of the 2010 ASA-IM grass carp feeding demonstration at the Wujiang Aquaculture Co. Ltd. Demonstration Farm, Jiangsu Province, China, that demonstrated production performance of grass carp fed the ASA-IM 32/3 extruded soy-based feed and a 28% protein sinking pelleted feed.

Pond GrC1 stocking Stocking rate No. days Harvest wt. (g) PG4 (kg/mu) Survival (%) FCR Net income ROI

 No.1 size (g) (GrC/mu) fed GrC2 SiC3 GrC SiC GrC SiC (RMB/mu) (%)

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 1 75 500 196 1,998 1,264 514.4 97.5 51.5 77.1 1.61 1,207.3 22.1

 2 75 500 196 1,494 1,334 524.7 99.5 70.3 77.6 1.60 1,341.8 24.6

 3 75 500 196 1,903 1,255 559.8 94.5 58.8 75.3 1.48 1,737.9 31.9

Mean 75 500 196 1,798 1,284 533.0 97.2 60.2 75.7 1.56 1,429.0 26.2

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 4 75 500 196 765 1,003 244.6 91.8 65 91.5 3.47 -806.4 -19.2

 5 75 500 196 897 1,104 268.0 99.8 60 90.4 3.11 -474.4 -11.3

 6 75 500 196 970 1,294 283.2 114 58.3 88.2 2.93 -231.3 -5.5

Mean 75 500 196 877 1,134 265.6 101.9 61.1 90.0 3.17 -504.0 -12.0

1Grass carp in ponds 1-3 were fed the ASA-IM formulated 32/3 extruded soy-based feed; grass carp in ponds 4-6 were fed a local sinking pelleted feed

2GrC = Grass Carp

3SiC = Silver Carp

4PG  = Gross Production

1. 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. [↑](#footnote-ref-1)