Grass Carp Performance on a Low Fat, High Fiber Feed Formulated With Soybean Meal and Soy Hulls as the Primary Protein and Fiber Sources

Results of ASA/China 2001 Feeding Trials 35-01-103/107/120

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ABSTRACT

Grass carp growth performance with the ASA 32/3 grass carp feed was demonstrated in three ASA 80:20 pond technology trials in 2001. The ASA 32/3 feed is a 32% crude protein, 3% fat and 8% fiber feed, formulated with standard soybean meal as the primary protein source and soy hulls as the primary fiber source. Trial sites for 2001 were in Harbin in Heilongjiang Province, Beijing, and Meixian in Guangdong Province. In all three trials, grass carp were fed to satiation with the ASA 32/3 feed in extruded, floating pellet form. Grass carp in the Harbin trial grew from 70 g to 713 g in 140 days with an estimated FCR of 1.59:1. Fish survival in the Harbin trial was 84%, and production averaged 360 kg per mu for grass carp and 124 kg/mu for silver carp. In the Beijing trial, grass carp grew from 125 g to 811 g in 181 days with an FCR of 1.41:1. Fish survival was 93% and production averaged 493 kg/mu for grass carp and 110 kg/mu for silver carp. In the Meixian trial, grass carp grew from 84 g to 1,053 g in 138 days with an FCR of 1.19:1. Fish survival was 96% and average production was 607 kg/mu of grass carp and 52 kg/mu of silver carp. Return to investment for the three trials ranged from 9.6% in Beijing to 47.4% in Meixian. The results of the three 2001 trials confirm results obtained in a 2000 trial in Beijing with the newly introduced ASA 32/3 grass carp feed. In the 2000 trial, grass carp grew from 100 g to 815 g in 174 days, with an FCR of 1.27:1 and average production of 502 kg/mu of grass carp and 139 kg/mu of silver carp. Collectively, the results of the four ASA grass carp trials conducted in 2000 and 2001 indicate that the ASA 32/3 grass carp feed yields good grass carp growth performance, low FCR, good fish body conformation, and good market acceptance. With high inclusion rates of standard (44% crude protein) soybean meal and soy hulls, the all-plant protein ASA 32/3 grass carp feed is a low-cost feed that has excellent application potential for China grass carp producers.

INTRODUCTION

The American Soybean Association (ASA), in cooperation with Jin Shan Bao Fish Farm in Harbin, the Xu Xing Zhuang Fish Culture Farm in Beijing, and the East Village Fish Farm in Longmen Town, Meixian County, Guangdong Province, conducted three feeding trials in 2001 to verify grass carp growth performance from fingerling to market size with the ASA 32/3, low-fat, high-fiber grass carp feed. A previous trial conducted by ASA in 2000 at the Xu Xing Zhuang farm in Beijing had demonstrated excellent grass carp growth performance and FCR with the newly developed ASA grass carp feed.

The ASA 32/3 grass carp feed is formulated to more closely mimic the natural food intake of grass carp, i.e. it is a low fat, high fiber, all-plant protein ration. Crude protein and amino acid concentrations in the 32/3 grass carp feed are the same as in the ASA 32/6 standard carp growout feed, but calculated digestible energy (DE-extruded) is 20% lower (2,602 kcal/kg vs. 3,254 kcal/kg for the 32/6 feed), and calculated fiber content is three times higher (8.5% for the 32/3 grass carp feed vs. 2.7% for the 32/6 feed).

Results of the three 2001 trials demonstrating grass carp growth performance with the ASA 32/3 grass carp feed are reported in this paper.

MATERIALS AND METHODS

Harbin

Two ponds of size 5.0-mu and 4.9-mu, respectively, at the Jin Shan Bao Fish Farm in Harbin, Heilongjiang Province, were used in the trial. Pond water was supplied from deep wells to an average depth of 1.5 m. All ponds were equipped with water exchange and stand-by aeration.

Fish were 100-g grass carp fingerlings produced in ponds at the Jin Shan Bao Fish Farm in 2000 and over-wintered to the spring of 2001. Grass carp fingerlings were stocked in the two trial ponds at a density of 600 fish per mu (9,000 fish/ha), together with 100 silver carp fingerlings per mu (1,500 fish/ha). Fish of both species were of uniform size and age at stocking.

Beijing

Three ponds of size 5.0-mu each at the Xu Xing Zhuang Fish Culture Farm in Beijing were used in the trial. Pond water was supplied from a deep well to an average depth of 1.5 m. All ponds were equipped with water exchange and stand-by aeration.

Fish were 125-g grass carp fingerlings produced in ponds at the Xu Xing Zhuang Fish Culture Farm in 2000 and over-wintered to the spring of 2001. Grass carp fingerlings were stocked in the three trial ponds at a density of 650 fish per mu (9,750 fish/ha), together with 100 silver carp fingerlings per mu (1,500 fish/ha). Fish of both species were of uniform size and age at stocking.

Meixian

Three ponds of size 3.5 mu, 3.5 mu and 3.0 mu, respectively, at the East Village Fish Farm in Longmen Town, Meixian County, Guangdong Province, were used for the trial. Pond water was supplied from a reservoir to an average depth of 1.5 m. All ponds were equipped with water exchange and stand-by aeration.

Fish were 84-g grass carp fingerlings produced in ponds at the East Village Fish Farm in 2000 and over-wintered to the spring of 2001. Grass carp fingerlings were stocked in the three trial ponds at a density of 600 fish per mu (9,000 fish/ha), together with 100 silver carp fingerlings per mu (1,500 fish/ha).

Grass carp in all three trials were fed the ASA 32/3 grass carp feed in extruded, floating pellet form (Table 1). Fish were fed to satiation twice daily, with fish in all ponds at each site fed the same amount at each feeding, as replicates of a single feed treatment.

Fish in all ponds at all trial sites were sampled once per month on the same date each month to monitor growth performance. At the conclusion of the trial, the ponds at each trial site were drained and the grass carp 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 trials and net income and ROI calculated at the end of each trial.

RESULTS

Harbin

Grass carp were fed a total of 140 days between 10 May and 25 September 2001 in the Harbin trial. Grass carp grew from 70 g to 713 g with an estimated FCR of 1.59:1 (Figure 1; Table 2). FCR was estimated due to inconsistencies in recording feed use in the two trial ponds. Average survival was 84% for grass carp in the two trial ponds.

Gross production averaged 360 kg/mu (5,400 kg/ha) for grass carp and 124 kg/mu (1,860 kg/ha) for silver carp (Table 2). The ratio of fed grass carp to filter feeding silver carp at harvest was 74:26, respectively.

Return on investment (ROI) was approximately 13.5% at market prices of RMB 8/kg for grass carp and 3/kg for silver carp (Table 2). Feed cost per kilogram of fish growth was RMB 4.77 at a FOB feed cost of RMB 3.00/kg.

Beijing

Grass carp were fed a total of 181 days between 16 April and 13 October 2001 in the Beijing trial. Grass carp grew from 125 g to 811 g with an FCR of 1.41:1 (Figure 2; Table 2). Average survival was 93.5% for grass carp in the three trial ponds. Gross production averaged 493 kg/mu (7,395 kg/ha) for grass carp and 110 kg/mu (1,650 kg/ha) for silver carp (Table 2). The ratio of fed grass carp to filter feeding silver carp at harvest was approximately 82:18.

Net income and return on investment were RMB 395/mu and 9.6%, respectively, for the three trial ponds, at market prices of RMB 8.4/kg for grass carp and 3.5/kg for silver carp (Table 2). Feed cost per kilogram of fish growth was RMB 4.23 at a FOB feed cost of RMB 3.00/kg.

Meixian

Grass carp were fed a total of 138 days between 1 April and 16 August 2001 in the Meixian trial. Grass carp grew from 84 g to 1,053 g with an FCR of 1.19:1 (Figure 3; Table 2). Average survival was 96.3% for grass carp in the three trial ponds. Gross production averaged 607 kg/mu (9,105 kg/ha) for grass carp and 52 kg/mu (780 kg/ha) for silver carp (Table 2). The ratio of fed grass carp to filter feeding silver carp at harvest was approximately 92:8.

Net income and return on investment were RMB 1,342/mu and 47.4%, respectively, for the three trial ponds, at market prices of RMB 6.6/kg for grass carp and 2.8/kg for silver carp (Table 2). Feed cost per kilogram of fish growth was RMB 3.57 at a FOB feed cost of RMB 3.00/kg.

COOPERATOR OBSERVATIONS

Harbin

The ASA soy-based, extruded grass carp feed resulted in less feed wastage than production with local feeds. The extruded feeds also did not deteriorate water quality. There was almost no surfacing of fish during the production season, and aerators were operated only five days during the entire summer season. We did not use any drugs or chemicals in the ASA trial ponds, and experienced no fish disease problems.

The major constraint to using extruded feed is the high price due to the cost of shipping the feed from mills in central or southern China to Harbin. Currently there are no mills producing extruded feed in the Harbin region. We were able to increase income from the trial ponds by adjusting our marketing strategy. We sold part of the fish to restaurants at RMB 10/kg, and part of the fish at the on-farm price of RMB 6/kg. This increased the average sales price for the grass carp from RMB 6/kg to RMB 8/kg.

Beijing

The Xu Xing Zhuang Fish Culture Farm was very impressed with grass carp growth performance on the ASA 32/3 grass carp feed in our initial trial in 2000. Not only was grass carp growth performance good with the feed, but the low FCR of 1.27:1 yielded a lower feed cost per kilogram of fish produced and a higher economic return for the farm. Water quality remained better using the extruded feed, and we had no disease problems in the ASA trial ponds. Grass carp cultured in other ponds with traditional methods had diseases. The body conformation of grass carp fed the 32/3 grass carp feed was thinner and closer in appearance to grass carp produced with traditional technologies than were grass carp fed the higher energy ASA 32/6 carp growout feed.

In the 2001 trial, the FCR was higher than in the 2000 trial because of abnormal climatic conditions this year. It was very dry in the Beijing area, with far less rain than normal and large temperature fluctuations. Feeding was reduced in June and July because of high water temperatures. The high temperatures and dry conditions impacted fish feeding behavior, growth performance and survival. Net income and ROI were reduced in the 2001 trial to RMB 395/mu and 9.6%, respectively, in comparison to RMB 1,068 and 31.7% in the 2000 trial.

Meixian

With the application of the ASA 80:20 pond culture model and ASA formulated low-fat and high-fiber grass carp feed, grass carp reached a maximum size of 1,700 g and an average size of 1,053 g after 138 days of culture. The average net yield of 604 kg/mu from the ASA trial ponds was much higher than the average local yield of 441 kg/mu.

With the use of extruded feed and the 80:20 pond production model, it is very convenient to manage ponds and labor costs are reduced fourfold in comparison to conventional culture practices. This provides a new, intensive fish culture system with high efficiency for the rural, hilly areas of Meixian.

We did not use any chemicals or drugs in the ASA trial, as there were no disease problems, except for one pond that was infected via discharged water from a nearby diseased pond that was not a part of the ASA trial. The water quality in the ASA trial ponds remained stable and aerators were not operated until July and August when water temperature and fish carrying capacity were high. This significantly reduced production costs.

The texture and meat quality of grass carp fed with the ASA extruded feed were as good as fish fed with grass. However, some improvement needs to be made on the further reduction of fat deposition for even better fish quality in the future.

In a word, with the application of the ASA 80:20 pond culture model and low-fat, high-fiber feed, grass carp exhibited fast growth performance, better utilization of feed, low FCR, and good body shape and meat quality in the trial. Moreover, the ASA technology also gave better economic return and ROI, easier management, low production cost, and less disease. The ASA farming practice is considered as a new approach for the development of environmentally friendly and sustainable freshwater pond aquaculture.

SUMMARY AND CONCLUSIONS

The series of grass carp feeding trials conducted at fish farms in Heilongjiang, Beijing and Guangdong Provinces in China indicate that the ASA 32/3 low-fat, high-fiber grass carp feed is a good, low-cost feed for the production of grass carp in 80:20 pond production systems. Comparison of grass carp performance in the numerous ASA trials conducted in 1999, 2000 and 2001 indicates that a reduction in feed energy content and the use of low-cost soy hulls as a fiber source reduces feed cost without sacrificing fish growth performance or feeding efficiency. It also results in the production of fish with a body conformation similar to fish fed fresh grass.

Results of the ASA feeding trials indicate that soy hulls can be effectively used as a low-cost fiber source in grass carp feed. Incorporation of 16% soy hulls in the ASA 32/3 grass carp feed formulation significantly reduced feed cost without lowering feed quality. Soy hulls used in the 32/3-grass carp feed were analyzed to contain approximately 31% fiber, 12% crude protein and less than 2% fat.

With high inclusion rates of standard (44% crude protein) soybean meal and soy hulls, the all-plant protein ASA 32/3 grass carp feed is a low-cost aquafeed that has excellent application for the China aquafeed and grass carp culture industries.

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- Xu Xing Zhuang Fish Culture Farm/Beijing
- Beijing Municipal Fisheries Extension Center
- East Village Fish Farm/Longmen Town
- Meixian County Fisheries Bureau
- Guangdong Provincial Fisheries Extension Center
- National Fisheries Extension Technology Center

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Cremer, Michael C. and Zhang Jian. 2000. Grass carp growth performance from fingerling to market size with a soy-based diet. Results of ASA/China 1999 Feeding Trial 35-99-64. American Soybean Association Publication AQ3-00, American Soybean Association Office, Shanghai, P.R. China.

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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

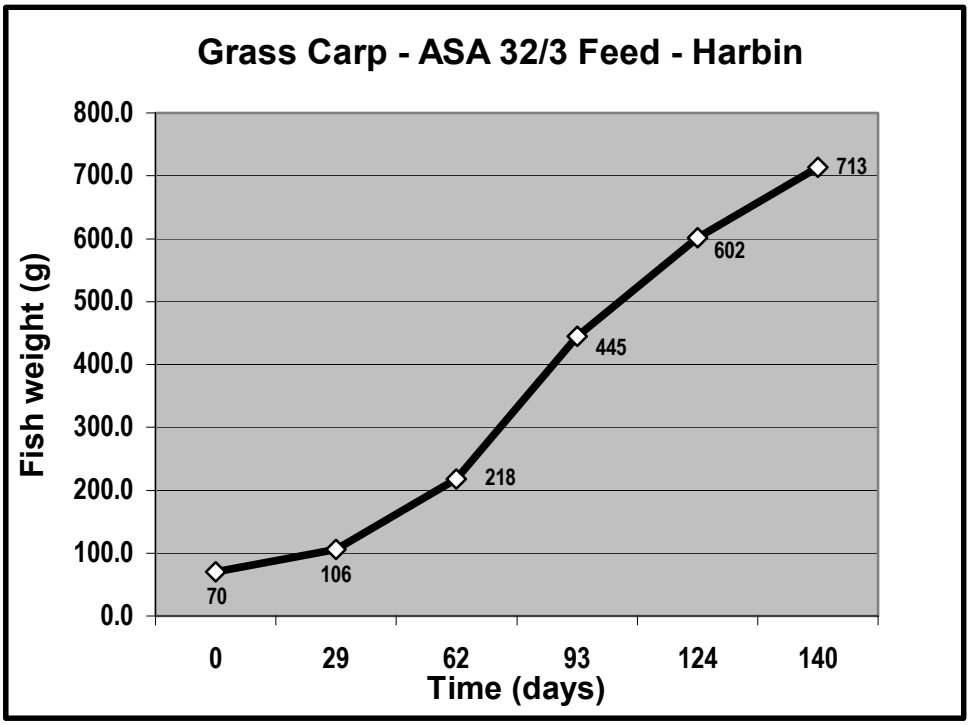

Figure 1. Growth curve for grass carp produced in ponds in the 2001 ASA feeding trial at Harbin with the ASA 32/3 grass carp feed. Grass carp grew from 70 g to 713 g in 140 days when fed to satiation twice daily with the 32/3 feed in extruded, floating pellet form. Grass carp were cultured using the ASA 80:20 production model at a stocking density of 600 fish per mu, together with 100 silver carp per mu.

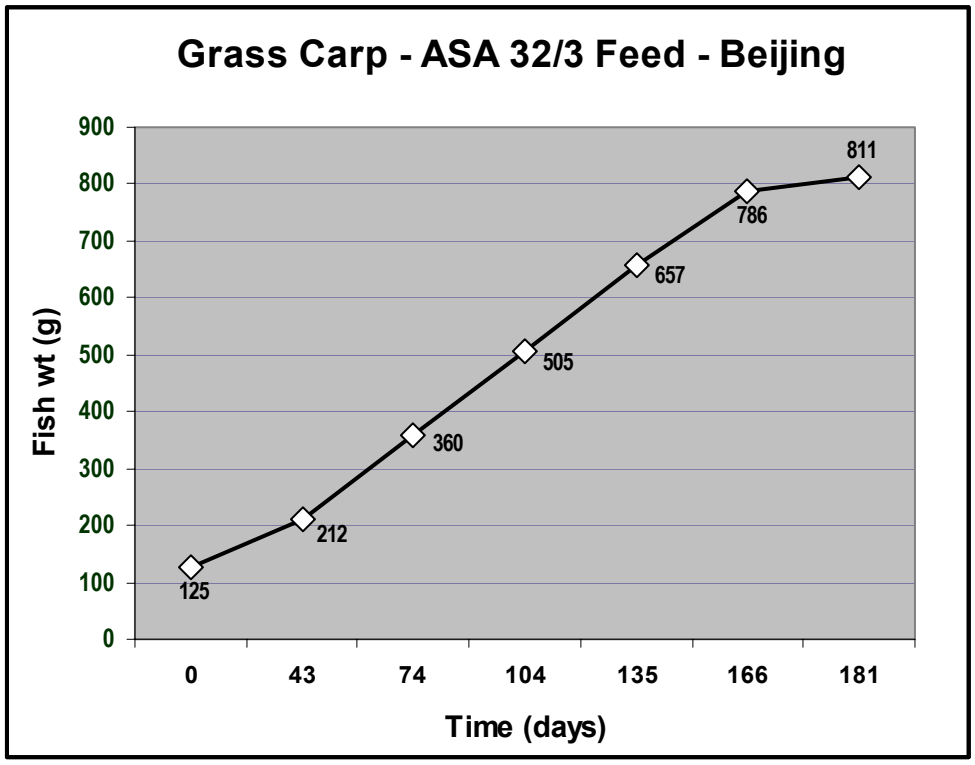

Figure 2. Growth curve for grass carp produced in ponds in the 2001 ASA feeding trial at Beijing with the ASA 32/3 grass carp feed. Grass carp grew from 125 g to 811 g in 181 days when fed to satiation twice daily with the 32/3 feed in extruded, floating pellet form. Grass carp were cultured using the ASA 80:20 production model at a stocking density of 650 fish per mu, together with 100 silver carp per mu.

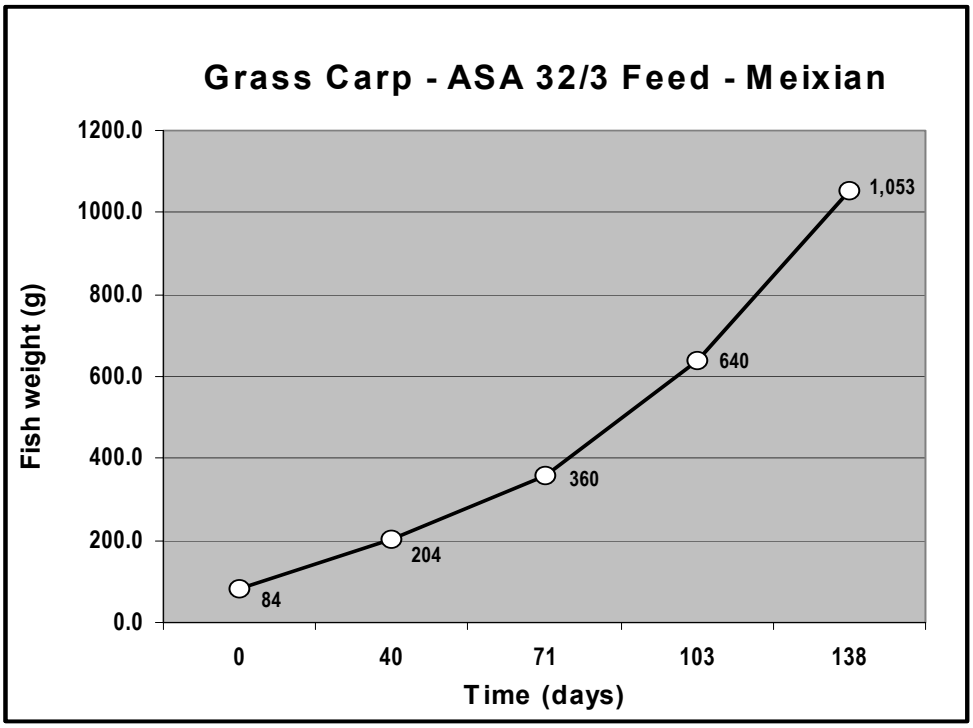

Figure 3. Growth curve for grass carp produced in ponds in the 2001 ASA feeding trial at Meixian with the ASA 32/3 grass carp feed. Grass carp grew from 84 g to 1,053 g in 138 days when fed to satiation twice daily with the 32/3 feed in extruded, floating pellet form. Grass carp were cultured using the ASA 80:20 production model at a stocking density of 600 fish per mu, together with 100 silver carp per mu.

Table 1. Formulation for the ASA 32/3 grass carp feed used in the 2000 and 2001 grass carp fingerling to market production trials at Harbin, Beijing and Meixian, China.[1]

Ingredient	32/3 Grass Carp Feed
Soybean meal 44 (standard)	50.00
Wheat, SWW	21.00
Soy hulls	16.00
Corn gluten meal 60%	8.90
Fish oil	1.30
Ca phosphate mono	2.43
Vit PMX Roche 2118	0.10
Min PMX F-1	0.25
Ethoxyquin	0.02
Total	100.00

[1]The numerical component of the feed description refers to the percentage of crude protein and fat, respectively, in the ration, e.g. 32/3 indicates 32% crude protein and 3% crude fat.

TABLE 2. Results of the 2001 ASA aquaculture trials at the Jin Shan Bao Fish Farm in Harbin, the Xu Xing Zhuang Fish Culture Farm in Beijing, and the East Village Fish Farm in Meixian that demonstrated fingerling to market growth performance and economic return of grass carp with the ASA 32/3, low fat and high fiber grass carp feed.

Location	Stocking size (g)	Stocking rate (GrC[1]/mu)	No. days fed	Harvest wt. (g)	P_G[3] (kg/mu) GrC	SiC[2]	Ratio GrC:SiC	Survival (% GrC)	FCR	Net income (RMB/mu)	ROI (%)
Harbin	70	600	140	713	360	124	74:26	84.0	1.59:1	-----	13.5
Beijing	125	650	181	811	493	110	82:18	93.5	1.41:1	395	9.6
Meixian	84	600	138	1,053	607	52	92:8	96.3	1.19:1	1,342	47.4

[1]GrC - Grass carp

[2]SiC - Silver carp

[3]P_G - Gross fish production