

Growth Performance of Grass Carp Fed a Low-Fat, High Fiber Feed Formulated With Soybean Meal and Soy Hulls As the Primary Protein and Fiber Sources

Results of ASA/China 2000 Feeding Trial 35-00-102

Michael C. Cremer, Zhang Jian and Zhou Enhua
American Soybean Association
Room 902, China World Tower 2
No. 1 Jianguomenwai Avenue
Beijing 100004, P.R. China

ABSTRACT

Grass carp growth performance in ponds was compared with two isonitrogenous feeds with different energy and fiber levels. One feed was the standard ASA/China 32/6 freshwater carp growout feed. This feed was formulated to contain 32% crude protein, 6% fat and 2.7% fiber, with dehulled soybean meal as the primary protein source. The second feed was a new ASA 32/3 grass carp growout feed formulated to contain 32% crude protein, 3% fat and 8% fiber, with standard soybean meal as the primary protein source and soy hulls as the fiber source. Both feeds were fed in extruded, floating pellet form to grass carp in a 6-month pond trial at the Xu Xing Zhuang Fish Culture Farm in Beijing. Grass carp fed the ASA 32/6 carp growout feed grew from 100 g to 825 g in 174 days with an FCR of 1.23:1. Grass carp fed the ASA 32/3 grass carp feed grew from 100 g to 815 g in 174 days with an FCR of 1.27:1. Fish growth was significantly different with the two feeds ($P < 0.05$), but there was no significant difference in FCR ($P > 0.05$). Gross production with the 32/6 carp growout feed was 513.7 kg/mu (7,706 kg/ha) for grass carp and 136.1 kg/mu (2,042 kg/ha) for silver carp. Gross production with the 32/3 grass carp feed was 502.3 kg/mu (7,535 kg/ha) for grass carp and 139.0 kg/mu (2,085 kg/ha) for silver carp. The ratio of fed grass carp to filter feeding silver carp was 79/21 and 78/22 for the 32/6 and 32/3 feeds, respectively. Net income per mu was RMB 871 for the 32/6 feed and RMB 1,068 for the 32/3 feed. Return on investment (ROI) was 23.9% with the 32/6 feed and 31.7% with the 32/3 feed. Net income per mu was 22.6% higher and ROI 32.6% higher with the low-fat, high-fiber 32/3 grass carp feed than with the 32/6 carp growout feed because of the significantly lower cost of the 32/3 feed.

INTRODUCTION

The American Soybean Association (ASA), in cooperation with Xu Xing Zhang Fish Culture Farm in Beijing, conducted a feeding trial to compare grass carp growth performance from fingerling to market size with 32% crude protein, soymeal-based feeds that varied in energy and fiber content. A previous trial conducted by ASA in 1999 at the Xu Xing Zhang farm had demonstrated grass carp growth from 100 g to 827 g in 178 days with an FCR of 1.19:1 with the standard ASA 32/6 carp growout feed (Cremer and Zhang, 2000). Net income and return on investment (ROI) for the 1999 trial were RMB 449/mu and 11.7%. The Xu Xing Zhang farm

manager was pleased with the results of the 1999 trial, but felt that the feed cost was too high and that grass carp produced in the trial did not have a traditional body conformation, i.e. they appeared to be too fat.

As a result, ASA formulated a special grass carp feed to test in 2000 that would more closely mimic the natural food intake of grass carp, i.e. a diet with lower fat and higher fiber content. This new ASA grass carp diet maintained crude protein and amino acid levels at the same levels as the ASA 32/6 carp feed, but reduced the calculated digestible energy level (DE-extruded) from 3,254 kcal/kg to 2,602 kcal/kg, and increased the calculated fiber content from 2.7% to 8.5%. In 2000, grass carp growth performance with this new feed was compared to grass carp growth performance with the ASA 32/6 carp growout feed that was tested in 1999. Results of the 2000 trial comparing these feeds are reported in this paper.

MATERIALS AND METHODS

Six ponds of size 5.0-mu (0.33-ha) each at the Xu Xing Zhang Fish Culture Farm in Beijing were used for this trial. Pond water depth averaged approximately 1.5 m. Pond water was supplied from deep wells. All ponds were equipped with water exchange and stand-by aeration.

Fish were 100-g grass carp fingerlings produced in ponds at the Xu Xing Zhang Fish Culture Farm in 1999 and over-wintered to the spring of 2000. Grass carp fingerlings were stocked in the six 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.

Grass carp in three of the ponds were fed the standard ASA 32/6 carp growout feed in extruded, floating pellet form (Table 1). Grass carp in the other three ponds were fed the new ASA 32/3 grass carp feed in extruded, floating pellet form (Table 1). Fish were fed to satiation, with fish in all six ponds being fed the same amount and on the same schedule.

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

RESULTS

Grass carp were fed a total of 174 days between 19 April and 10 October 2000. Grass carp fed the ASA 32/6 carp growout feed grew from 100 g to 825 g with an FCR of 1.23:1 (Figure 1; Table 2). Grass carp fed the new ASA 32/3 grass carp feed grew from 100 g to 815 g with an FCR of 1.27:1 (Figure 1; Table 2). Fish growth was significantly different with the two feeds ($P<0.05$), but there was no difference in FCR ($P>0.05$).

Gross production averaged 513.7 kg/mu (7,706 kg/ha) for grass carp and 136.1 kg/mu (2,042 kg/ha) for silver carp with the 32/6 carp growout feed (Table 2). Gross production averaged 502.3 kg/mu (7,535 kg/ha) for grass carp and 139.0 kg/mu (2,085 kg/ha) for silver carp with the 32/3 grass carp feed (Table 2). The ratio of fed grass carp to filter feeding silver carp was 79/21 and 78/22 for the 32/6 and 32/3 feeds, respectively.

Net income per mu was RMB 871 for grass carp fed the 32/6 feed, and RMB 1,068 for fish fed the 32/3 feed, at market prices of RMB 8/kg for grass carp and RMB 3/kg for silver carp. ROI was 23.9% for fish fed the 32/6 feed, and 31.7% for fish fed the 32/3 feed. Net income per mu was 22.6% higher and ROI 32.6% higher with the low-fat, high-fiber grass carp feed than with the 32/6 carp growout feed. Feed cost per kilogram of fish growth was RMB 4.19 for the 32/3 grass carp feed and RMB 4.80 for the 32/6 carp growout feed. Lower feed cost per unit of fish growth for the grass carp feed was related to the difference in ingredient cost for the two feeds.

SUMMARY AND CONCLUSIONS

Reducing the energy level and increasing the fiber content of a 32% crude protein diet resulted in marginally lower grass carp growth, but the same FCR and a significantly higher economic return. The reduction in feed energy content and the use of low-cost soy hulls as a fiber source resulted in a 13% reduction in feed cost that yielded a 22.6% higher profit level for grass carp fed the low-fat, high fiber grass carp feed. Large-scale production of the ASA 32/3 grass carp feed by local feed mills in grass carp production areas can further reduce feed production and delivery costs, and increase profit margins, for grass carp producers.

Grass carp growth and FCR were good with both of the ASA feeds tested in the 2000 trial. Grass carp growth performance with the ASA 32/6 carp growout feed was the same in 2000 as it was in 1999, i.e. 100 g to 825 g in 174 days in 2000, versus 100 g to 827 g in 178 days in 1999. FCR was also the same, i.e. 1.23:1 in 2000 versus 1.19:1 in 1999. In comparison, the ASA 32/3 grass carp feed yielded only marginally lower growth than the 32/6 carp growout feed, i.e. from 100 g to 815 g in 174 days, with no difference in FCR. However, feed cost per kilogram of fish growth was reduced from RMB 4.80 for the 32/6 carp growout feed to RMB 4.19 for the 32/3 grass carp feed.

Soy hulls were demonstrated to be a low-cost and effective fiber source for use 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 31.4% fiber, 11.7% crude protein and 1.6% fat¹.

The Beijing farm trial manager observed that 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 32/6 carp growout feed. However, the observation was anecdotal and was not quantified through measurement of samples from the two feed treatment populations. It was planned to have fish samples from each of the two feed treatments analyzed for visceral and total body fat content, but the Beijing farm was unable to complete this component of the trial analyses.

¹ Feed ingredient analysis was conducted by the Hagerman Fish Culture Experiment Station, University of Idaho, Hagerman, Idaho, USA.

ACKNOWLEDGEMENTS

ASA gratefully acknowledges the Beijing Xu Xing Zhang Fish Culture Farm, the Beijing Municipal Fisheries Extension Center, and the Director and staff of the National Fisheries Extension Center for their assistance and support for this aquaculture trial.

LITERATURE CITED

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.

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

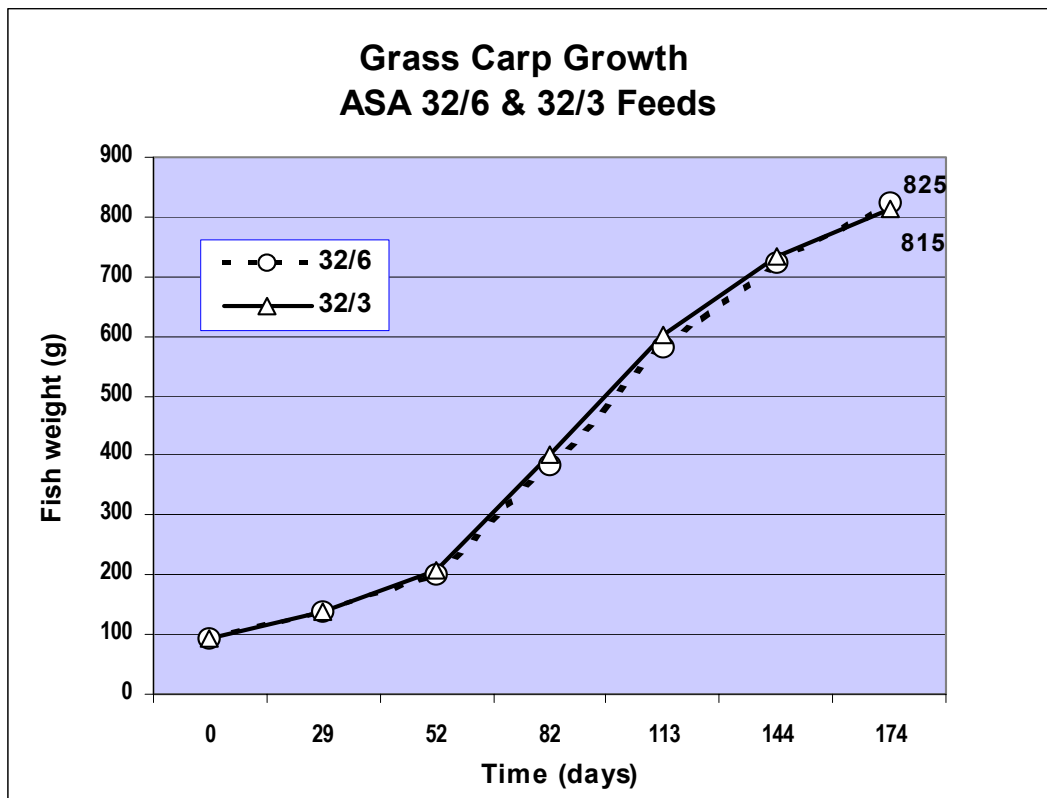


FIGURE 1. Growth curves for grass carp produced in ponds with the ASA standard 32/6 freshwater carp growout feed and a new ASA low-fat, high-fiber 32/3 grass carp feed. Grass carp growth was marginally lower with the 32/3 feed, i.e. 815 g versus 825 g, but FCR was the same for the two feeds. Net income and ROI were significantly higher with the 32/3 grass carp feed because of lower feed cost.

Table 1. Formulations for the ASA 32/6 carp growout and 32/3 grass carp feeds used in the 2000 grass carp fingerling to market production trial at the Xu Xing Zhang Fish Culture Farm in Beijing, China.¹

Ingredient	32/6 Carp Growout Feed	32/3 Grass Carp Feed
Soybean meal 47.5 (dehulled)	52.80	-----
Soybean meal 44 (standard)	-----	50.00
Wheat, SWW	23.60	21.00
Soy hulls	-----	16.00
Wheat middlings	10.00	-----
Corn gluten meal 60%	6.00	8.90
Fish oil	3.53	1.30
Soy lecithin	1.00	-----
Ca phosphate mono	2.70	2.43
Vit PMX Roche 2118	0.10	0.10
Min PMX F-1	0.25	0.25
Ethoxyquin	0.02	0.02
Total	100.00	100.00

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

TABLE 2. Results of the 2000 ASA aquaculture trial at the Xu Xing Zhang Fish Culture Farm, Beijing, that compared fingerling to market growth performance and economic return of grass carp with the ASA 32/6 carp growout feed and a new ASA 32/3, low-fat and high fiber grass carp feed.

Feed type	Stocking size (g)	Stocking rate (GrC ¹ /mu)	No. days fed	Harvest wt. (g)	P _G ³ (kg/m ³)		Ratio GrC:SiC	Survival (%)	FCR	Feed price (RMB/kg)	Net income (RMB/m ³)	ROI (%)
32/6 Carp Growout	100	650	174	825 ^a	513.7	136.1	79:21	95.7 ^g	1.23 ⁱ	4.80 ^j	870.73 ^l	23.9 ⁿ
32/3 Grass Carp	100	650	174	815 ^b	502.3	139.0	78:22	94.8 ^h	1.27 ⁱ	4.19 ^k	1,068.07 ^m	31.7 ^p

¹GrC = Grass carp

²SiC = Silver carp

³P_G = Gross fish production

Treatment means followed by different superscripted letters are significantly different (P<0.05); treatment means followed by the same superscripted letter are not significantly different (P>0.05);