INTENSIVE MIXED-SEX CULTURE OF NILE TILAPIA

INDAR W. RAMNARINE

Department of Life Sciences, the University of the West Indies, St Augustine, Trinidad and Tobago

Indar.Ramnarine@sta.uwi.edu

Abstract

Trials were conducted in 100m^3 octagonal concrete tanks using juvenile mixed-sex Nile tilapia of mean weight 51 g ± 3.25 in a green water system. Solids were removed via an internal, cone-shaped clarifier. Fish were stocked at densities of 500, 1000, 1500 and 2000 per tank and were grown for a period of 24 weeks. They were fed at 3% biomass twice daily using 32% crude protein floating pellets. Production ranged from 210 kg to 984 kg while survivorship ranged from 81% to 93%. The mean weight of the fish ranged from 422 g to 505 g. The trials indicate that recruitment levels were surprisingly low and that all the fish produced were marketable.

INTRODUCTION

There are basically three systems of culturing tilapia: extensive, semi-intensive and intensive systems. Extensive systems require low capital input and are greatly influenced by environmental conditions. Earthen ponds or natural water bodies are used and low stocking densities are employed. Little or no feeding is practised. Tilapia production levels depend to a great extent on the natural productivity of the ponds and yields do not generally exceed 1 ton per ha. Semi-intensive systems are generally conducted in earthen ponds using hatchery produced fingerlings. Supplemental feeding is practiced and the natural productivity of the pond is harnessed. Supplemental aeration is normally done. Production levels can be as high as 5 tons per ha per crop. Intensive systems usually employ circular tanks, raceways and crossways. Intensive systems generally require high capital inputs, continuous aeration and the feed used is nutritionally complete. Cost of production is high and precise management is a pre-requisite for success. Yields can be as high as 100 tons per ha per crop (Watanabe *et al.*, 2002).

Tanks vary in size, shape, and composition. The preferred shape is circular with sloping bottoms and central drainage. Concrete and fiberglass are the most popular materials although plastic, metal and ply-board are also used. Concrete tanks can be as large as 35 m in diameter. A clear-water or green-water system may be utilized and water may be changed daily or re-circulated after filtration. Yields as high as 10 to 15 kg/m^2 is common (Losordo, 1997). While concrete tanks are better that square or rectangular tanks, their cost of construction is much higher. In these trials, octagonal tanks were used. The cost of construction was 25% less than circular tanks since walls are shared.

MATERIALS AND METHODS

Four octagonal concrete tanks were constructed as indicated in Plate 1. Tanks were built using concrete blocks which were reinforced with steel rebar and grouted with concrete. The inner walls were rendered with a sand and cement mixture to give a smooth surface. The tanks were 10 m in length and width, with the long sides of the octagon being shared. The walls were 1.2 m in height and the floor of each tank drained to a centre cone 1.5 m in diameter with a 60° slope. The floor sloped toward the centre drain at a 5° angle. Drainage of the tanks was on the outside via 100 mm PVC pipes and gate valves. The tanks were continuously aerated via 4 30-cm fused silica airstone per tank, connected to a 3 HP blower.

Each tank was stocked with juvenile silver tilapia, *Oreochromis niloticus,* of mean weight 52 g ± 2.64 SD, and cultured for a period of 24 weeks. Different stocking densities were used (500, 1000 and 1500 fish per tank) and three trials have been completed thus far.

Plate 1. Octagonal concrete tanks

The tanks were partially drained daily by opening the gate valve and allowing solids that settled in the cone to be removed. Duration of drainage ranged from 3 minutes to 5 minutes. The tanks were topped up twice weekly and periodically flushed when water quality parameters approached critical values. Water quality (pH, dissolved oxygen, ammonia and nitrite) were measured weekly while turbidity was measured twice weekly.

The fish were fed twice per day with a 32% CP tilapia floating feed, at a daily rate of 3% biomass, and their behavior and health were monitored. The fish were weighed individually after they were harvested.

RESULTS

The results of the three trials are summarized in Table 1.

Table 1. Summary of the three completed trials

TANK #	Number stocked	Number harvested	Survivorship (%)	Yield (kg)	Mean weight (g)	FCR
1	500	419	83.80	209.86	500.86	2.36:1
2	1000	855	85.50	431.78	505.01	1.97:1
3	1500	1397	93.13	697.66	499.40	1.77:1

As can be seen from the table, survivorship ranged from 84% to 93% while the mean weight of the fish was fairly uniform ranging from 499 g to 505 g. There was, however, some fluctuation in the size and weight of the fish harvested in each tank. The weight distribution is presented in Figures 1, 2 and 3.

Figure 1. Weight frequency distribution of Trial # 1

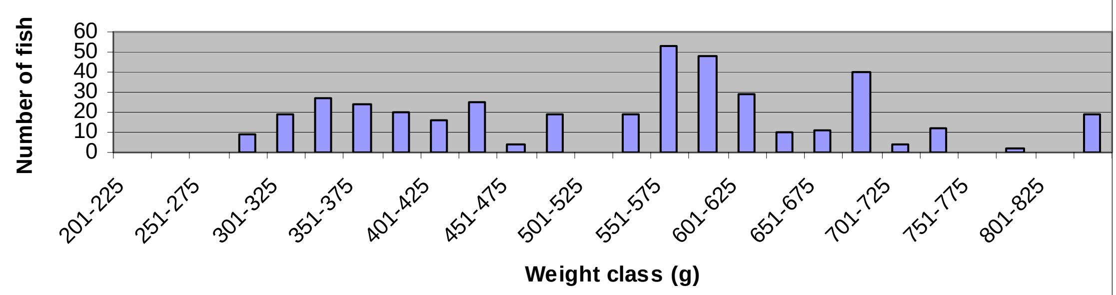

Figure 2. Weight frequency distribution of Trial # 2

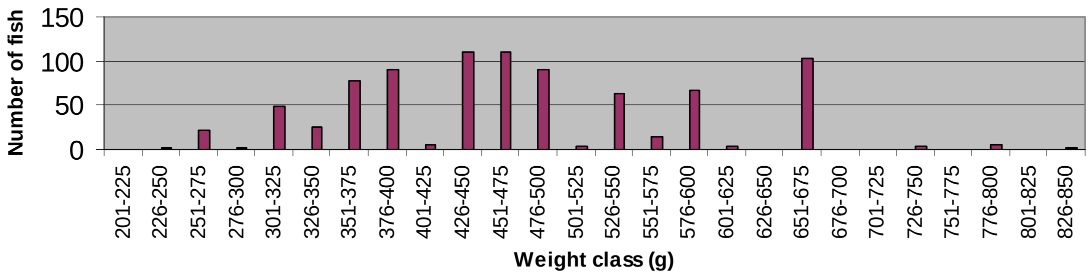

Figure 3. Weight frequency distribution of Trial # 3

Water quality varied, as expected, among the three tanks. Fluctuations of water quality parameters, as measured in the three tanks during the trials, are summarized in Table 2.

Table 2. Range in water quality parameters during in each trial.

TANK #	Water temperature °C	pH	Turbidity (Secchi Disc cm)	Ammonia (ppm)	Nitrites (ppm)	Dissolved Oxygen (ppm)
1	26-29	7.2 - 8.3	28 - 35	0.3 – 0.5	0.4 - 0.8	5.2 – 5.8
2	26-29	7.2 - 8.7	29 - 38	0.2 – 0.5	0.3 - 0.7	5.1 – 5.6
3	26-29	7.2 - 8.6	26 - 38	0.3 – 0.8	0.3 - 1.2	5.2 – 5.6

DISCUSSION

The results of the trials clearly show that growth rates, survivorship and yields were favorable in the octagonal concrete tanks and are similar to those in circular concrete tanks (Siddiqui *et al.*, 1991; Sadek *et al.*, 1992). Initial stocking rates were low and results obtained suggest that stocking rates can be markedly increased in future trials, but whether similar yields can be achieved at elevated stocking densities with this system in comparison with circular tanks cannot be determined at this stage. The results also indicate that males and females grew at a fast rate and that recruitment was minimal since very few small fish were harvested. Spawning would have taken place in the tanks but most likely, the fry would have been consumed by juvenile tilapia or other predators such as birds that might have entered the tank. The number of small fish produced was surprisingly low and this result is very encouraging for the future of this system since there are concerns about tilapia that have been masculinised using hormones (Ramnarine, 2003).

Size-distribution analyses (in terms of weight) indicate that at the lower stocking densities, there was a greater range in weight of the harvested fish with some large fish being produced. At the higher stocking densities, the size range was smaller, but with many smaller fish being produced. Nevertheless, the small fish were over 200 g and were still marketable, but at a lower piece per unit weight.

These trials are preliminary and future work will be done on increasing stocking densities in order to determine the optimal stocking rates for this system. In addition, trials will be done with the inclusion of limited numbers of picivorous fish in order to control or prevent recruitment from taking place.

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