GROWTH PERFORMANCE OF NILE TILAPIA (*Oreochromis niloticus* L.) SUBJECTED TO DELAYED STOCKING AND FEEDING

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Abstract

This study was conducted to evaluate the growth performance of Nile tilapia *O. niloticus* subjected to delayed stocking and feeding during first feeding stage. This study consisted of two phases. Phase I focused on the early stage growth during nursery period ($1m^3$ fine-mesh hapa) and Phase II on the late stage growth in B-net cage (2m x 2m x 1m) and earthen pond of approximately 200 m^2.

The delay in stocking and feeding result in decrease in weight although the length continued to increase. Analysis of variance revealed significant difference in initial weight ($P<0.01$) and length ($P<0.001$) among the treatments.

After 43 days of nursery, fish in T1 attained the largest mean weight of 2.10 g while T3 showed the lowest at 1.74g. T5 had the highest mean percent survival with 99.74% while T3 had the lowest at 98.83%. No significant differences were observed on the weight and survival of fry ($P>0.05$).

Analysis of variance on the final weight and length of the fish in cage and pond showed some contrasting results. In cage culture, no significant difference was observed on final weight and length ($P>0.05$) of fish while in pond culture, gain weight and length ($P<0.001$) were significantly different. However, no apparent similarity on the growth pattern of the five treatments in both culture environment. Similarly, the percent survival of the five treatments in cage was not significantly different ($P>0.05$) and no apparent large discrepancy of the mean percent survival in pond.

No significant difference on the mean percent dressed out weight and percent fillet weight of the five treatments in cage ($P>0.05$) were observed.

The results of the study indicate that the delay of stocking and provision of first exogenous food has no harmful effect on the late stage growth and survival of the fish.

Introduction

Tilapias, which is considered as "everyman's fish" have become a top priority in aquaculture because of their ability to efficiently use natural foods, being herbivore in nature, resistant to diseases and handling, ease of reproduction in captivity, and tolerant to wide range of environmental conditions and relatively grow fast and can easily be bred (Guerrero, 1982). Tilapias (Family Cichlidae), such as the Nile tilapia *Oreochromis niloticus* are mouth-brooders and they exhibit a high degree of parental care. The eggs are incubated and hatched inside the mouth of the mother and the hatched fry are only released when the reserve yolk is absorbed and the fry are able to swim. The fry begin to swim freely in schools, but may return to the mouth of the mother when threatened by predators. In natural environment where there are lots of opportunistic predators and danger can be everywhere, the mother would sometimes extend the period of care therefore delaying the release of her broods to safeguard them from being eaten. While this instinct may be effective in ensuring the survival of fry, it can also result in the delay of exogenous feeding or inability of the fry to feed efficiently.

In hatchery conditions, delay in stocking and feeding of fry may also occur when nursery containers are not available or insufficient. First feeding fry are usually held in hatching jars/aquaria until containers are available or prepared. Delaying of stocking and feeding also occur when the farmer unconsciously failed to check that the fry have already absorbed their yolk and are ready to eat exogenous food.

For mouth-brooding species such as *O. niloticus,* where the anti-predator tactic of buccal rearing prevails, partial or total food deprivation of fish larvae or fry during the transition from endogenous to exogenous feeding may seriously impair growth and survival (Hewitt *et al.,* 1985). Due to these potential implications of oral incubation, this study was conducted to investigate the effect of delayed stocking and provision of exogenous food during first feeding stage on growth and survival from fry up to adult stage. The determination of potential harmful effect would be important information to fish farmers to avoid the delay in stocking and feeding of tilapia fry.

Materials and methods

This study composed of two phases; Phase 1 focused on the determination of the effect of delayed stocking and feeding on the early stage of growth and survival of Nile tilapia fry during nursery period in $1m^3$ hapa and Phase 2 focused on the effect of delayed stocking and feeding on the late stage of growth and survival of Nile tilapia in B-net cages (2m x 2m x 1m) and earthen pond of approximately 200 m^2.

Prior to conduct of the experiment, a preliminary trial was performed to determine the number of days the fry can endure starvation. Three plastic basins with a diameter of 27 cm were filled with tap water to a depth of 6 cm and in each basin two hundred (200) first feeding fry, all from the same brood, were temporarily held. No food was provided to the fry. Continuous flow of water from an overhead tank was provided to maintain good water quality and to provide sufficient oxygen in the system. The fry were observed to be very weak on day 8 and total mortality was observed on day 9. The information gathered from this preliminary trial served as the basis for determining the different treatments to be used in the actual experiment.

Phase 1

A total of eight "families" (term given to the fry from each brood) were used in the study and served as replicates. Fry used in the study were from crosses of YY males and normal XX males (GMT Release 4). The fry in each family were counted and divided into five groups (treatments) each consisting of two hundred (200) "first feeding fry" (fry ready to eat exogenous food). Each treatment was placed in a plastic basin similar in preliminary trial. The basin served as temporary holding unit for the fry until the scheduled stocking. While still in the basin no food was provided to the fry. When scheduled to be stocked, the fry were transferred into $1m^3$ fine mesh hapa installed in 200 m^2 earthen pond and provided initial exogenous food. A total of 40 $1m^3$ hapas were used in the study.

The fry were stocked and provided initial exogenous food at different periods starting from day 0 (estimated period when the fry had totally absorbed their yolk reserved and starts taking in exogenous food). The treatments were: Treatment 1 (T1) was immediate stocking of fry and provided initial food after yolk absorption (Control); Treatment 2 (T2) was fry stocked and fed 2 days after yolk absorption, Treatment 3 (T3) was fry stocked and fed 4 days after yolk absorption, Treatment T4 was fry stocked and fed 6 days after yolk absorption, and Treatment 5 (T5) was fry stocked and fed 8 days after yolk absorption. The experiment was laid out in a completely randomized design (CRD). Before the fry were stocked, initial weight and total length of ten samples from each treatment was determined using weighing balance and Vernier caliper. Fry were fed with commercial Fry Booster (48% Crude Protein) at 100% biomass given twice daily between 0800 – 0900 H and 1500–1600 H. Forty three days after stocking, all survived fingerlings were counted and bulk weighed to determine growth and survival.

Phase 2

Five of the eight replicates in Phase 1 that had the highest survival were further grown to determine growth and survival during late stage in cages (3 replicates) and earthen pond (2 replicates). In cage 15 2m x 2m x 1m B-net cages installed in an approx. 200 m^2 earthen pond were used and laid out in a randomized complete block design (RCBD). Random representatives from treatment/replicate were stocked at a density of 20-fish/m^3 or a total of 80 per cage. Five treatments each represented with fingerlings from the two replicates (pooled) were stocked communally in an earthen pond of approx. 200 m^2 area at a density of 4.5 fish/m^2 or a total of 900 per pond (180 fish treatment). Stocked fish were clipped either at the right or left pectoral or pelvic fin for marking.

Before stocking, the initial length and weight of the fish were measured using a Vernier caliper and a digital weighing balance. The pond was supplied with water from a shallow well and supplemented with wastewater from a circular tank used for growing tilapia to replenish seepage and evaporation losses. Inorganic fertilizer such as ammonium phosphate (16-20-0) and urea (46-0-0) were applied to the pond twice a month or as needed at a combined rate of 15 g/m^2 by dissolving first in water and splashed on the pond surface to enhance growth of natural food. Fish were fed with commercial grower diet (31% Crude Protein) at 5% biomass in cage and 3% biomass in pond given twice daily between 0800-0900 H and 1500-1600 H. Biweekly sampling of the fish in hapa and monthly sampling of the fish in pond was done to determine growth and to adjust feeding rate.

Water temperature, dissolved oxygen (DO) concentration and pH were determined at biweekly interval using DO meter (Model YSI 54A) and pH meter (Hannah model).

After 105 days in cages and 131 days in pond, the fish were harvested, counted and individually measured and weighed to determine final growth and survival. Length and weight were measured using ruler and weighing balance, respectively. In cage, 10 samples of the harvested fish from each replicate were dressed-out and filleted to determine percent dress-out and percent fillet.

All data collected were analyzed using the Statistical Package for Social Sciences (SPSS) version 1997. In Phase 1, data were analyzed using One-way Analysis of Variance (ANOVA). In Phase 2, data from grow out in cage were analyzed using Analysis of Variance in General Linear Model. Comparison among treatment means was determined using Duncan's Multiple Range Test (DMRT). The data from the grow out in pond were analyzed using One-way Analysis of Variance (ANOVA).

Results

Phase 1

The delay in stocking and feeding result in decrease in weight although the length continued to increase (Table 1). Analysis of variance revealed significant difference in initial weight ($P<0.01$) and length ($P<0.001$) among the five treatments. After 43 days of nursing in 1.0 m^3 fine mesh hapas the mean weight and mean percent survival of the fish were found not significantly different ($P>0.05$) among each other (Table 1).

Phase 2

Table 2 presents the initial mean length and weight of fish for grow-out in cages and pond. The initial length and weight of fish in cages were all statistically similar ($P>0.05$). In pond the mean lengths and mean weights ranging from 4.26 – 4.56 cm and 3.10 – 3.64 g, respectively, were both significantly different among the five treatments ($P<0.001$). The observed significant differences in mean weight and length among the five treatments in pond is possibly due to the individual fish being used as replicates.

Figure 1 shows the growth pattern of the fish in the five treatments during grow out period in cages and in pond. The fish in the five treatments in cage grow comparatively from stocking to harvest. In pond similar trend was also observed beginning from stocking of the fish up to 3rd month period but slightly changed during the last month of rearing.

For the final results, in cage no significant differences were observed on the mean final length and weight among the five treatments (P>0.05). In pond, the mean gain in length and weight of the five treatments were significantly different (P<0.001). However, no apparent similarity on the growth pattern of the fish in the five treatments in both culture environments and the pattern is not correlated with the delay in stocking the fry and feeding (Figure 2).

The percentage survival of the fish in the five treatments in cage were not significantly different (P>0.05) and there was no apparent large discrepancy of the mean percent survival in pond.

No significant difference on the mean percent dressed out weight and percent fillet weight of the fish in the five treatments fish in cage were observed (P>0.05). Similarly, no apparent discrepancy on the distribution of final length of all the fish in cage and in pond was observed (Figure 3).

Table 1. Growth parameters of fry before stocking and feeding and after 43 days nursery in fine mesh 1m^3 cages.

Growth parameters	Treatments				
	1	2	3	4	5
Initial length (mm)	6.29±0.46b	6.91±0.20a	7.14±0.23a	7.11±0.33a	7.16±0.28a
Initial weight (mg)	10.11±0.69a	10.13±0.93a	9.95±0.82a	8.38±1.39b	8.91±1.15b
Final weight (g)	2.10±0.23a	2.03±0.42a	1.74±0.40a	1.84±0.55a	2.02±0.96a
Survival (%)	99.61±0.77a	98.87±2.31a	98.43±2.77a	98.99±0.95a	99.74±0.69a

Means within a row with the same letter script are not significantly different at 5% probability.

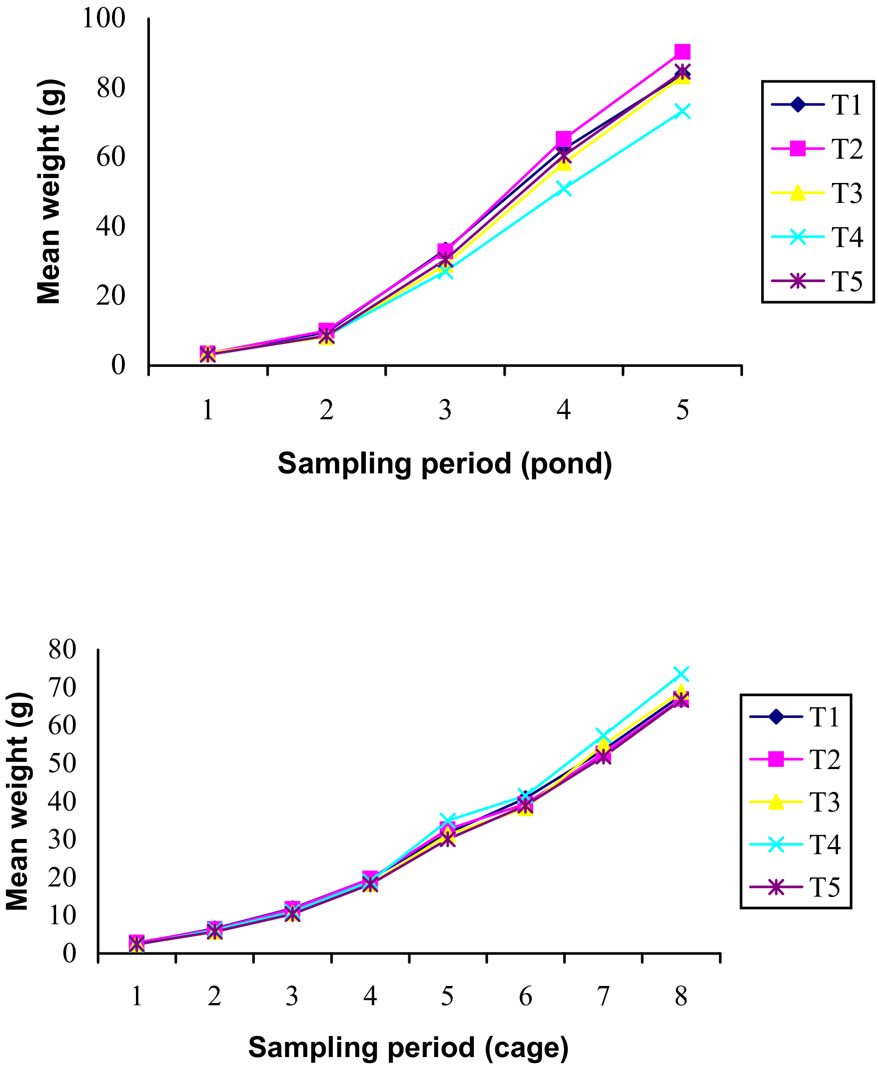


Figure 1. Mean weight of Nile tilapia in cage and pond at different sampling periods.

Table 2. Growth parameters during grow out in cages and earthen pond.

Culture environment	Growth parameters	Treatments				
		1	2	3	4	5
Cage in Pond	Initial length (cm)	4.18±0.03a	4.10±0.15a	3.96±0.04a	3.94±0.11a	3.93±0.17a
(Separate rearing in 2 x 2 m net cages installed in approximately 200 m^2 earthen pond with 3 replicates)	Initial weight (g)	2.71±0.04a	2.89±0.24a	2.46±0.16a	2.33±0.28a	2.41± 043a
	Final length (g)	12.04±0.34a	12.02±0.45a	12.03±0.41a	12.06±1.14a	11.70±0.3)a
	Final weight (g)	67.93±5.76a	67.03±2.89a	68.88± 5.94a	73.52±20.63a	66.67± 4.80a
	Survival (%)	79.58±29.96a	97.08±2.60a	77.92±36.08a	73.33±41.88a	92.92± 6.29a
	Dressed out weight (%)	78.45± 1.07a	79.55±1.16a	80.41±1.35a	78.99±2.22a	77.91±0.72a
	Fillet weight (%)	31.91±2.67a	31.66±2.14a	33.16±1.04a	32.45±2.52a	31.35±1.09a
Earthen pond	Initial length (cm)	4.51±0.30a (100)	4.56±0.38a (100)	4.40±0.31b (100)	4.26±0.31c (100)	4.36±0.36b (100)
(Communal rearing in one approximately 200 m^2 earthen pond)	Initial weight (g)	3.41±0.59b (100)	3.43±0.86b (100)	3.64±0.70a (100)	3.18±0.64c (100)	3.10±0.61c (100)
	Final gain length (g)	8.46±0.86a (143)	8.54±1.01a (143)	8.55±0.98a (141)	8.07±1.10b (154)	8.67±1.00a (137)
	Final gain weight (g)	84.01±17.33b (143)	90.49±19.55a (143)	83.31±18.51b (141)	73.38±19.12c (154)	84.80±18.04b (137)
	Survival (%)	79.44	79.44	78.33	85.56	76.11

Means within a row with the same letter script are not significantly different at 5% probability.

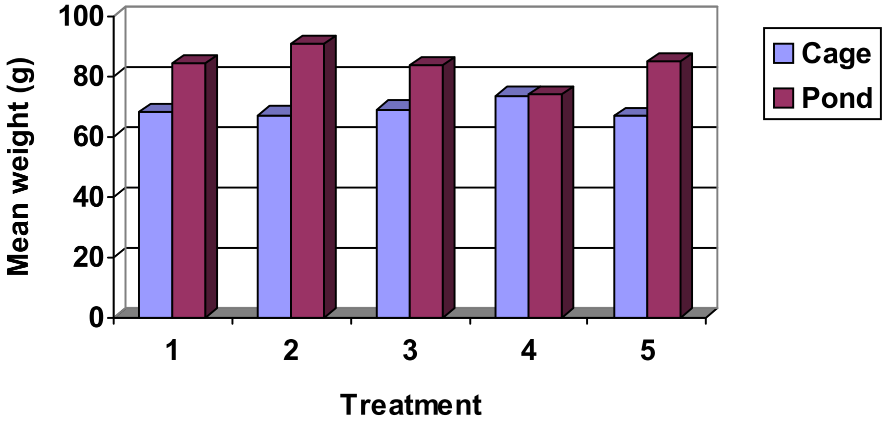
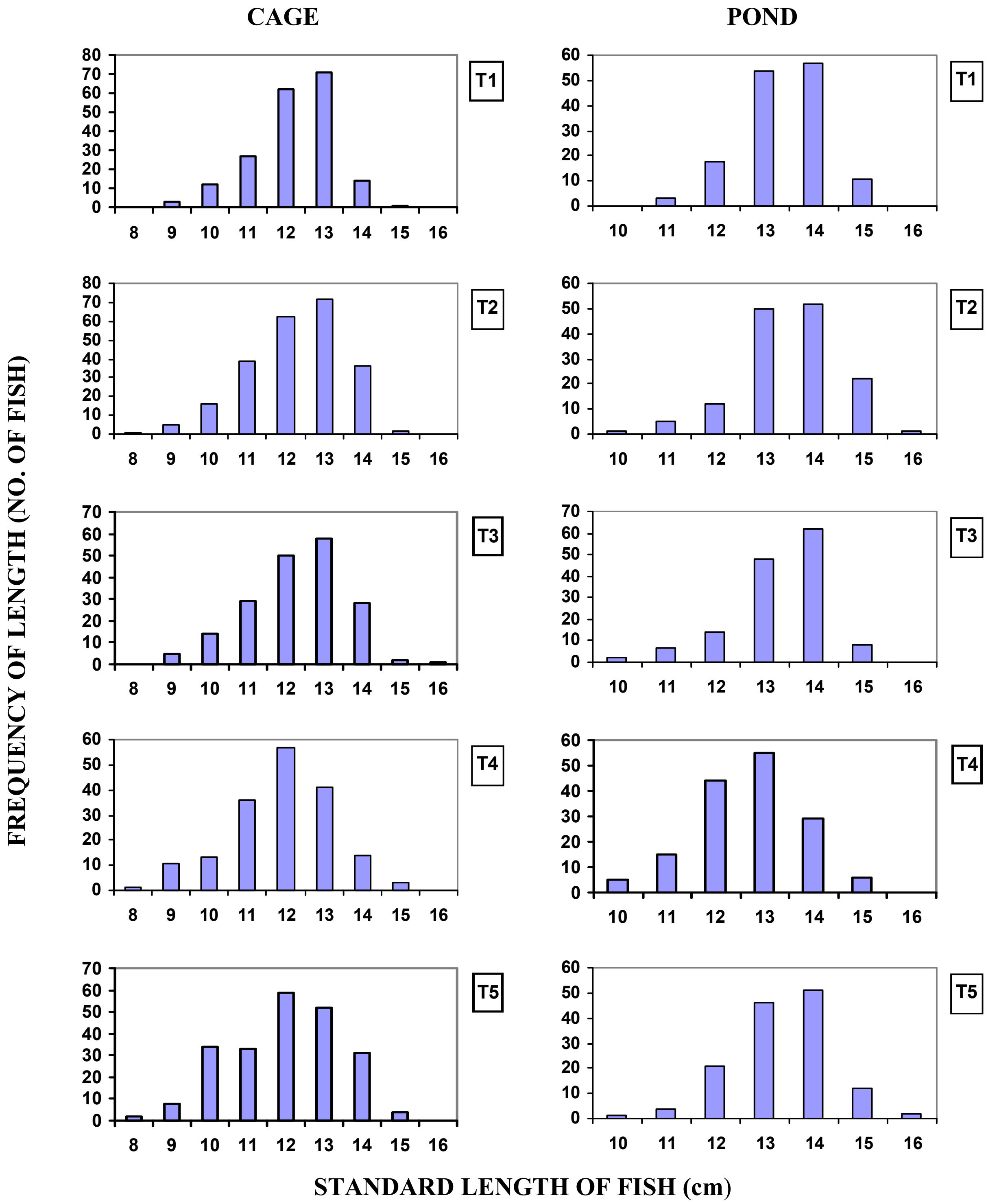


Figure 2. Final mean weight of the five treatments in cage and pond.

Discussion

The result of the study indicated that the delay in stocking and provision of initial exogenous food could affect weight during period of starvation. The fish were observed to decrease in average weight. The present results conform to the result of Rana (1990). He observed that a delay in feeding of fry in both *O. niloticus* and *O mossambicus* of 6-18 days post-hatching decreased their condition factor (weight-to-length relationship). However, when the fry were stocked in cages installed in pond rich with natural food and provided their initial exogenous food the lost weight during starvation were readily compensated and able to catch up with those non-starved fry. The results of grow out where the fish also comparatively grow provide further support to the proposition that the delay in stocking and provision of initial exogenous food to fry would not harmfully affect the growth in later life stage. Similarly, the result also indicated that the starved fry could readily recover when food become available as shown by the relatively similar percent survival among the different treatments.

In commercial grow out of tilapia, many factors are being put forward as a possible justification for the poor growth of stocked fish. One frequent factor is the quality of the seed. The deterioration of seed quality could be due to genetic and/or environment factors. One possible aspect of environmental factor is the delay of stocking and feeding. In many fishes the delay in feeding from the absorption of the yolk sac has harmful effect on growth. However, in tilapia where the mother may deliberately delay the release of its brood during times of danger, the delay in feeding is a common phenomenon. The ability of the fry to readily compensate for the lost weight without any harmful effect could have been part of their evolutionary development leading to mouth brooding.



Figures 3. Length frequency distribution of all the fish in cage and in pond.

The result of the study, which shows that the delay in stocking and likewise feeding has no harmful effect on growth and survival, provide additional interesting information on the biology of tilapia. Likewise, it also exonerates the notion that the delay in feeding has harmful effect on the growth of tilapia.

The results of the study indicate that the delay of stocking and provision of first exogenous food has no harmful effect on the growth and survival of the fish.

Recommendation

This study only evaluated the growth performance of Nile tilapia subjected to delayed stocking and feeding. It maybe interesting to know if similar result would also transpire in non-mouth brooding species of tilapia such as those substrate spawners.

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