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Rashmi Prabha Mishra
Programme Assistant, (Fishery Sc.), Krishi Vigyan Kendra, Angul, Odisha, India

Jyotiprabha Mishra
Scientist (Animal Science), Krishi Vigyan Kendra, Sambalpur, Odisha, India

Navin Kumar
Agriculture Coordinator, District Agriculture Office, Samastipur, India

Nihar Ranjan Sarang
Additional Veterinary Assistant Surgeon, VD, Jamankira, Sambalpur, Odisha, India

Corresponding Author:
Rashmi Prabha Mishra
Programme Assistant, (Fishery Sc.), Krishi Vigyan Kendra, Angul, Odisha, India

A comparative study on growth & economic performance of Monosex Nile tilapia (*Oreochromis niloticus*, Linnaeus, 1758) fed with floating pallet type against composite culture with Indian major carps

Rashmi Prabha Mishra, Jyotiprabha Mishra, Navin Kumar and Nihar Ranjan Sarang

Abstract
The Experiment was done for a period of six months with an objective to assess the effect of floating pellet type of feed on growth of Monosex Nile Tilapia in cement tank system with respect to composite culture of mixed Tilapia with IMC in traditional earthen ponds. The experiment included three treatments in triplicates *viz.* TO1: Catla (*Catla catla*), Rohu (*Labeo rohita*), Mrigal (*Cirrhinus mrigal*) & mixed seeds of Nile Tilapia *(Oreochromis niloticus*) stocked in earthen ponds of (90 m^2)area @ 25 fry/m^2; TO2: Monosex Nile Tilapia stocked in cement tanks of (20 m^2) area @ 50 fry/m^2, floating pellet feed given@ 10% of their body weight ; and TO3: Monosex Nile Tilapia stocked in cement tanks of (10 m^2) area @ 75 fry/m^2 & floating pellet feed given @ 30% of their body weight. Water samples were collected from the ponds/cement tanks at 15-day intervals during morning hours and important parameters were measured following standard methods.Then the data like Average fish weight (gm), fish yield (Quintal/hectar), average net return and B: C was recorded and analysed using statistical tools like Average mean value, frequency and percentage. In the present experiment stocking of Monosex Nile Tilapia of recommended size and density in cement tank system along with following the post stocking management schedules resulting the increase in weight of Monosex Tilapia upto 475 gm where as the weight of mixed Tilapia with IMC remains 200 gm after six months of observation. Net profit of Rs. 83,800 was obtained from this technology with benefit: cost (B: C) ratio of 2.99 in(T3) against Rs. 38,600 and 2.23 respectively from farmer's practice (T1) due to more fish growth & production. Similarly 80% increase in fish yield was also observed in this technology (18 q/ha) against farmer's practice (10 q/ha).

Keywords: Comparative study, growth & economic performance, Monosex Nile tilapia, floating feed

Introduction
From aquaculture point of view, the Nile tilapia, *Oreochromis niloticus* has been regarded as one of the most valuable fish species in tropical and sub-tropical contries [21]. The majority of tilapia currently produced in India is strains of Nile tilapia. The GIFT tilapia derived from the breeding programme at JITRA, Malaysia, coordinated by World Fish, were introduced to the Central Institute of Freshwater Aquaculture (CIFA) in Bhubaneswar [39] and are now the most popular of the Nile tilapia strains male mono-sex tilapia [35]. There is significant sex-specific difference in the growth of fish where males usually grow faster and more uniform in size than females [13]. The farming of Tilapia can be possible under various environmental conditions [26, 19]. They are having fast growth rate with higher food conversion ratio, higher fecundity, hardy in nature, disease resistant, easy to breed under captive conditions, tolerates stress caused by rough handling [14]. Besides, as the fishes mature in four to five months, farmers can harvest at least two crops per year. GIFT can grow to market size (600-700 g) within 6 months of crop duration and can yield 3-4 tons/acre/crop. It has very good consumer acceptance qualities such as attractive light grey coloration, tasty white meat with single bone. According to the UN-FAO, tilapia is one of the fastest growing variety of farmed fish around the world, and along with carps and catfish, it will take a share of more than 60% of the total global farmed fish production. These characteristics make tilapia suitable for culture in most developing countries [19].

However, their prolific breeding nature has been created a major problem i.e. stunted growth in pond culture system [35] & within a short duration of culture pond becomes overpopulated resulting in less yield & income. Genetically Improved Farmed Tilapia (GIFT), a fast growing & high yielding and valued fish species has been introduced in Odisha. The importance of monosex Nile Tilapia has been established in many commercial contexts but there are relatively few studies published comparing the growth performance of monosex Nile tilapia in cement tank system with mixed-sex tilapia, under composite culture with IMC, especially from the Indian perspective. Hence, the propagation potentiality of sex-reversed tilapia under various Conventional and non-conventional culture practices must be clearly documented. Thus, the main objective of this study is to boost the fish production status through species diversification strategy, to bring more foreign exchange earnings, to improve the socioeconomic status of farmers, to create more employment avenues & to provide nutritious protein diet through Tilapia farming in a sustainable manner under various culture systems.

Materials and Methods

The Experiment was done for a period of six months with an objective to assess the effect of floating pellet type of feed on growth of Monosex Nile Tilapia in cement tank system with respect to composite culture of mixed Tilapia with IMC in traditional earthen ponds. For this study one farmer having three no. of earthen ponds of average 90 m^2 area were selected as Farmers practice (T_1) & another two farmers having cement tank of avg. 20 m^2 & 10 m^2 area were selected as Recommended practice (T_2 & T_3) respectively. Monosex Nile Tilapia & mixed Tilapia was procured from Largest Private fish seed hatchery of Balasore, Odisha & provided to selected farmers of different villages of Angul district. The experiment included three treatments in triplicates *viz.* TO1: Catla (*Catla catla*), Rohu (*Labeo rohita*), Mrigal (*Cirrhinus mrigal*) & mixed seeds of Nile Tilapia *(Oreochromis niloticus*) stocked in earthen ponds of (90 m^2)area @ 25 fry/m^2; TO2: Monosex Nile Tilapia stocked in cement tanks of (20 m^2) area @ 50 fry/m^2, floating pellet feed given@ 10% of their body weight ; and TO3: Monosex Nile Tilapia stocked in cement tanks of (10 m^2) area @ 75 fry/m^2 & floating pellet feed given @ 30% of their body weight. To create mass awareness among farmers regarding scientific and Intensive pond management practices, various Off Campus and On Campus training programmes were conducted in the selected villages. Moreover, to motivate for adopting this technologies, critical inputs were also supplied to them. Water samples were collected from the ponds/cement tanks at 15-day intervals during morning hours and important parameters were measured following standard methods [7]. Fish yield was recorded after harvesting of fishes from the pond & tank. Then the data like Average fish weight (gm), fish yield (Quintal/hectar), average net return and B: C was recorded and analysed using statistical tools like Average mean value, frequency and percentage.

Results & Discussion

During the culture, the pH of water varied between 7.24–8.15 in cement tank system with monoculture practice & ranged between 6.9-8.9 in earthen pond system with mixed culture of Tilapia with IMC (Table 1). Temperature varied between 13.8 – 24.68 ^{0}c in tank system with monoculture technique & ranged between 14.5-24.6^0 c in earthen pond with mixed culture practice. Dissolved oxygen remained between 5.2 to 6.2 mg/l in monoculture method whereas it varied between 5.0 to 6.1 mg/l in mixed practice. The total alkalinity varied between 86.2 to 114 mg/l in monoculture method in a cement tank system & it ranged between 90.4 to 114.3 mg/l in earthen pond with mixed culture practice. The other water parameters like, transparency and hardness did not record any marked trend in the treatments during the culture (Table 1).Total Ammonia Nitrogen contents in water varied insignificantly in treatments within a range of 0.53 to 0.67 mg/l. Nitrite and Nitrate did not show any marked variation among the treatments. Most of the water quality parameters in the ponds and tanks during the culture were within suitable limit for Tilapia culture It might be due to management measures taken at regular interval of time i.e. liming, fertilization and water exchange. These results are in accordance with the findings of who reported that in the Indian subcontinent, most of the water bodies had their temperature lying between 7.8 oC and 38.5 oC. Dissolved oxygen had an inverse relationship with water temperature in fish ponds. In general, no significant input of water quality on fish growth was noticed and water quality remained congenial for the growth of experimental fish. Thus, the significant variations in growth rate of both the treatment groups (i.e., monosex and mixed sex) could be due to the sex and hormone treatment. Based on the above data, the key water quality parameters: temperature, dissolved oxygen, pH, hardness and alkalinity measured during the study period were all within the optimum limit for tilapia culture [24, 43, 12]. Weight of tilapia was found more in T3 (475 g) than those of T1 (200 g) and T2 (420 g) respectively after 180 days of observation (Table 3). The highest growth obtained in T3 might be due to use of floating feed with probiotics, which is having many beneficial bacteria. The present study is in agreement with the findings of [4] who found final weight of tilapia as 207.90 - 271.48 g at 50m-3 densities over 120 days rearing in suspended cages fed with commercial diet supplemented with probiotics at Dakatia river, Chandpur [30] has demonstrated that final weight of tilapia attained from 167.15 to 189.67 g for a 99 days period reared in net cages given floating feed without probiotics in a pond of Sylhet Agricultural University (SAU). Although, the growth performance of *Oreochromis niloticus* is highly influenced by genetics, quality and quantity of food, stock management and environmental factors, sex-specific differences in the growth of *O.niloticus* is apparent [13, 41]. The other factors might be due to: composition and quality of feeds [40] stocking density [8, 9], feeding methods [36], feeding frequency [18, 23], availability of food resources in ponds or cages, and feeding rate [34, 29], fish rearing duration [22, 37]. The other intrinsic factors related to the animal include: genetic background of the fish species [6], difference between the initial weights [1], sexual dimorphism [13, 36, 42, 14].

O. niloticus juvenile of monosex culture showed final mean body weight of 402.18 ± 137.05 g, higher than the values of 255.53 ± 16.36; 227.24 ± 15.05; 206.36 ± 14.06 and 172.62 ± 14.89 g reported for similar populations reared for 120 days and fed with a commercial pelleted floating feed (29% protein) at 3-5% of body weight in cages at densities of 50,75, 100 and 125 fish/m3 respectively [32]. This might be due to the difference in the protein content of fish feed, the stocking density, and the trial duration. It is also found out that an increase in stocking density results in lower body weight of fish. On the other hand, lower final mean body weight values

of 200.08 ± 0.8 and 123.4 ± 0.76 g were also reported respectively for juvenile monosex male and mixed sex populations of the same species after 6 months of pond culture (3 fish/m2) using 28% crude protein diet twice daily at 4% body weight [25].

The results of the present study revealed that the growth performance between all male and mixed-sex *Oreochromis niloticus* reared for 180 days was significantly different, where the male mono-sex fish attained a larger final individual size which is nearly twice the mixed-sex group [24]. Several investigators have studied the sex-specific growth difference of *Oreochromis niloticus* under semi-intensive pond culture system. For example, [14, 16, 2] documented the faster growth of all male tilapia than females and mixed-sex. This might be attributed to sex-specific growth ability [38], female mouth brooding behavior or the efficient feeding habits of males. Similarly 80% increase in fish yield was also observed in this technology (18 q/ha) against farmer's practice (10 q/ha). [4] obtained 9.93-11.63 kg m-3 of tilapia in cages at 50 m-3 densities, which is much higher than the yield of the present study. Similar higher yield i.e. (7.7 - 9.4 kg m-3) reported by [5, 33, 20]. Net profit of Rs. 83,800 was obtained from this technology with benefit: cost (B: C) ratio of 2.99 in (T3) against Rs. 38,600 and 2.23 respectively from farmer's practice (T1) due to more fish growth & production which might be due to the many beneficial bacteria present in the probiotic added floating feed and efficient utilization of the supplied feed by reducing the feed wastage cost. Similar results were also obtained by [31].

Table 1: Ranges of water quality parameters of different Experimental ponds/Tanks during the culture period under three treatments

Parameters	Treatments		
	TO_1	TO_2	TO_3
pH	7.8 (6.9-8.9)	7.24-8.15	7.47-8.11
Transparency (cm)	16.1-71.6	15.9-57.7	13.8-57.1
Temperature (0 C)	14.5-24.6	14.6-24.68	13.8- 24.9
Dissolved Oxygen (mg l-1)	5.0-6.1	5.2-6.0	5.4-6.2
Alkalinity (mg l-1)	90.4-114.3	86.2-109.6	87.2-114.0
Hardness (mg l-1)	110.4-137.2	113.2-143.8	110.0-136.0
Ammonia (mg l-1)	0.53-0.67	0.55-0.62	0.59-0.66
Nitrate (mg l-1)	0.43-1.82	0.82-1.96	0.63-1.68
Nitrite (mg l-1)	0.25-0.36	0.23-0.42	0.27-0.35
Phosphate (mg l-1)	0.15-0.26	0.14-0.26	0.18-0.24

Table 2: Abstract of fish yield

Sl No.	Pond /Tank area (ha)	Yield (q/ha)				% change in yield	Production (qtl.)			
		R1	R2	R3	Avg. (q/ha.)		R1	R2	R3	Avg. (qtl.)
1	Pond of Avg. 90 m^2 / 0.009 ha. (T1)	12.4	8.2	9.4	10	-	0.112	0.074	0.085	0.09
2	Cement Tank of Avg. 20 m^2 / 0.002 ha. (T2)	16.8	17.6	17.2	17.2	72	0.034	0.035	0.034	0.034
3	Cement tank of Avg. 10 m^2 / 0.001 ha. (T3)	21.4	14.2	18.4	18	80	0.021	0.014	0.018	0.017

Table 3: Abstract of economic parameters

Technology option	No. of replications	Yield component	Change in parameter (%)	Cost of cultivation (Rs./ha)	Gross return (Rs/ha)	Net return (Rs./ha)	BC ratio
		Avg. Fish growth after 6 months observation (Fish wt. in gm)					
FP (T_1)	3	200	-	31,400	70,000	38,600	2.23
RP (T_2)	3	420	110	41,000	1,20,400	81,400	2.93
RP (T_3)	3	475	137.5	42,200	1,26,000	83,800	2.99

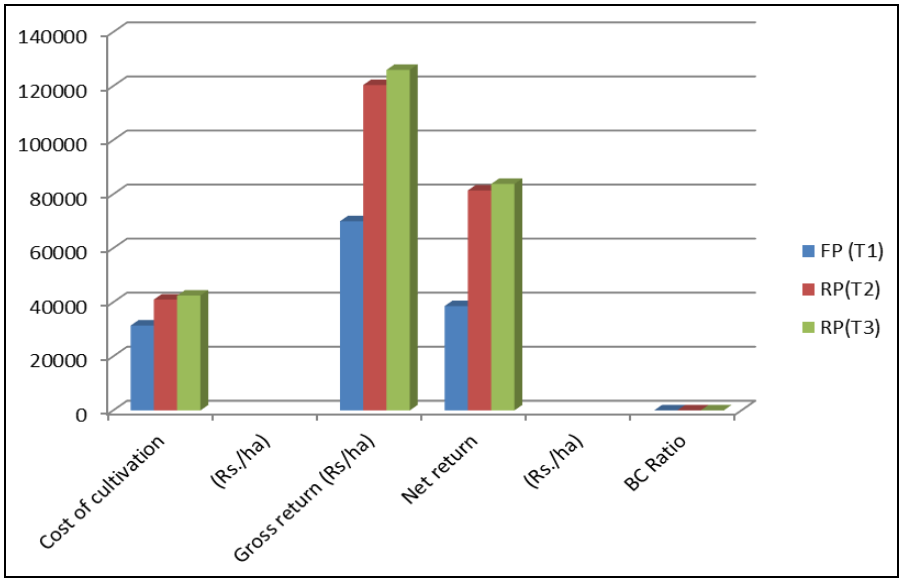

Fig 1: Economic analysis of different treatments

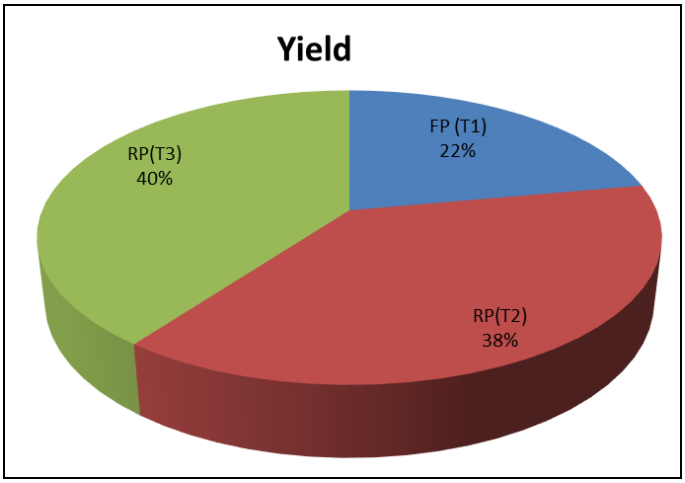

Fig 2: Yield analysis among different treatments

Conclusion

The data obtained from our study on growth parameters of monosex (all male) and mixed sex of red tilapia with IMC clearly indicated better performance of all male population. Thus for the sustainable and higher growth/yield, the culture of monosex male Tilapia is ideal. It is more profitable in cement tank system with less stocking density. So it is advisable to culture only male Tilapia for avoiding its prolific breeding nature. But proper success of this technology can be achieved by adopting Better Management Practices (BMPs) & by following Proper bio-security measures recommended by Government of India. Then only fish production can be augmented, animal protein requirement of our country can be fulfilled, foreign exchange earnings can be increased & employment opportunities can be expanded which ultimately leading to the fulfillment of the main objective of fishery sector of India. Besides this, owing to the wide distribution of this species in our country, its market demand & consumer preference, priority should be given on further modification and improvements of the culture techniques of this species. Moreover, further research is required to increase the feed utilization efficiency during such culture.

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