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THE INFLUENCE OF STOCKING DENSITY ON THE GROWTH PERFORMANCE AND REPRODUCTION OF TILAPIA (*Oreochromis niloticus*) IN EARTHEN POND

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ABSTRACT

An experiment was carried out to investigate the influence of stocking density on the growth of the initial stocked tilapia (O.niloticus) in earthen ponds, the effect on the reproductive performance of the fish and impact on the economy of production. Six African Regional Aquaculture Centre (ARAC), Aluu, Port Harcourt earthen genetic ponds split into three compartments representing three replicates were stocked with 666 fingerlings of 4.33g average initial weight and 6.06cm average initial length at 37 per replicate. They were fed with a 28%CP blood meal based diet for nine months. The size of the ponds and depth of water was such as to attain average stocking densities of 6.33, 6.45, 5.05, 3.60, 2.88 and 2.05 fish/m^3. The result showed distinct increase in growth as the stocking densities decreased. Ponds 5,6 and 4 with lower densities 2.88, 2.05 and 3.60 fish/m^3 having higher final weights of 146.10, 120.79 and 108.69g than ponds 3, 2 and 1 with 85.37, 74.36 and 59.68g respectively ($P<0.05$). Average final length was higher in ponds 5, 6 and 4 at 14.46, 13.86 and 13.79cm than ponds 3, 2 and 1 with 12.09, 10.62 and 11.36cm. Relative weight gain followed suit with 3274.13, 2689.61 and 2410.16% in ponds 5, 6 and 4 as against 1871.59, 1617.32 and 1277.83% in 3, 2 and 1. Percentage survival increased as stocking density decreased at 28.18, 35.45, 37.27, 40.91, 41.82 and 45.45% for the 6.33, 6.45, 5.05 , 3.60, 2.05 and 2.88 fish/m^3 treatment respectively, with the 3.60, 2.05 and 2.88fish/m^3 treatment significantly higher ($P<0.05$). The 2.88fish/m^{3}treatment (treatment 5) also provided the cheapest cost of producing 1kg of fish at ₦178.74 as against ₦457.14, ₦351.44, ₦312.41, ₦242.81 and ₦217.25 per kg fish of treatments 1, 2, 3, 4 and 6 respectively. The total number of off-springs produced all in progressive sizes increased as the stocking density decreased at 1530, 1636, 1674, 2053, 3160 and 3234 for ponds 1-6. The experiment showed that tilapia fingerlings stocked in earthen pond at low densities grow and reproduce more and at a lower cost of production than those with higher stocking densities. The ideal appears to be between 2 and 3 fish/m^3.

INTRODUCTION

Tilapia in earthen pond multiply at will giving rise to the problem of over stocking such as retardation of growth and low efficiency of production (Vijayan and Leather land, 1988). For this reason, the fish appears to be unsuitable for commercial culture in Nigeria. However, due to its widespread occurrence, growth on natural grazing or formulated feed, with no constraint for seed production and so could be raised for food, seed production, sale or restocking (Little 1998), it has the potential to be the greatest source of food fish. Allison *et al*, 1979 working with *Tilapia aureus* suggested that its high fecundity could be controlled by high stocking density. Dada (2005) reported on previous works that growth and stocking density are inversely related and vary from specie to specie. An appropriate stocking density could thus be investigated for the fish in earthen ponds at which good growth of the initially stocked fish could be attained, reasonable survival and production of off-springs in good numbers that could grow also at the same time over a stipulated period. This experiment was thus designed to subject the nile tilapia (*Oreochromis niloticus)* one of the most abundant in Nigeria to such a trial.

MATERIALS AND METHODS

Trial Enclosure

Six African Regional Aquaculture Centre (ARAC), Aluu, Port Harcourt genetic ponds were cleared, desilted and limed. They were split into three units each with fine mesh nylon netting and impounded with tidal water from the New Calabar River, and stocked with 666 fingerlings of tilapia (*O.niloticus)* acquired from ARAC pond 22, at the rate of 37 per unit. Average initial weight was 4.33g and length of 6.06cm.

Determination of stocking density

The surface area of each pond was measured as differences had resulted from burrowing action of fish, erosion and gradual collapse of pond wall due to water action. The depth of water in each pond was also measured as the rains increased and tidal volume rose, to determine the average volume of water in the ponds through the trial period. The number of fish per m^3 space was thus worked as shown in table 2.

Feed Formulation and Production

A 28%CP diet was formulated based on blood meal and wheat bran, with soyabean cake, bone meal, vitamin/trace mineral premix and methionine as shown in Table 1. All the ingredients except blood meal were batched and thoroughly mixed. Thereafter, blood meal was added in the form of fresh cattle blood (8kg blood meal equivalent to 50kg fresh blood). The mixture was heaped for 24 hours and then sundried to produce feed crumbs. The proximate composition of the feed was calculated as shown on table 1.

Feeding trial

The produced feed was fed to the fish in all the ponds to satiation twice daily, five days a week. Every month, sampling was done on the stocked fish to enable the determination of body weight and length and also to observe the presence of new off-springs.

Water quality monitoring parameters such as PH and temperature were measured using the pen type PH meter (with temperature display).

At the end of the ninth month the fish were harvested and the final weight and length measured. Growth parameters were computed and means subjected to analysis of variance (ANOVA).

Table 1: Ingredient and Calculated chemical composition of experimental diet

Ingredients	% of diet
Wheat bran	63.01
Blood meal	9.97
Soya bean cake	22.94
Bone meal	3.06
Vitamin/trace mineral premix	0.38
Methionine	0.54
Total	**100%**
Calculated Chemical Composition:	
A Crude Protein	27.52
B Ether Extract	3.66
C Ash	6.99
D Crude fibre	6.29
E Moisture	12.47
F NFE	43.07

Table 2: Estimation of Stocking Density

Pond number	Surface area (m^2)	Av. Depth of water (m)	Vol. stocked (m^3)	No. of fish stocked	Stocking density
1.	34.74	0.5	17.37	111	6.39
2.	34.11	0.5	17.06	111	6.51
3.	36.34	0.6	21.8	111	5.09
4.	43.62	0.7	30.53	111	3.64
5.	42.75	0.9	38.48	111	2.88
6.	57.07	0.95	54.22	111	2.05

Table 3: Physico-chemical parameters

Parameter	Pond 1	Pond 2	Pond 3	Pond 4	Pond 5	Pond 6
PH	6.3	6.2	6.4	6.0	6.5	6.6
T^oC	26.05	26.3	26.12	26.03	26.03	26.25

RESULT AND DISCUSSION

The result of growth performance, feed utilization, survival and cost benefit effect were as shown on Table 4 and 5. Average final weight was higher in the 2.88, 2.05 and 3.64 fish/m^3 treatments (ponds 4,5 and 6) than the 6.3, 6.45 and 5.05 fish/m^3 treatment (ponds 1,2 and 3) at 108.69, 146.10 and 120.79g as against 59.68, 74.36 and 85.37g respectively ($P<0.05$).

Average final length also followed suit with 13.79, 14.46 and 13.86cm in ponds 4,5 and 6 as against 11.36, 10.62 and 12.09cm in ponds 1,2 and 3, respectively ($P<0.05$). All the growth parameters showed progressive increases as the stocking density reduced until 2.88 fish/m^3 in pond 5, where the highest values were obtained. Average weight gain was 55.33, 70.03, 81.04, 104.36 and 141.77g for ponds 1-5 respectively and declined in pond 6 to 120.70g. Relative weight gain followed the same trend at 1277.83, 1617.32, 1871.59, 2410.16 and 3274.13% for ponds 1-5 respectively and declined in pond 6 to 2689.61%. These values agree with Dada (2005) report that there is an inverse relationship between growth and stocking density. It also agreed with the findings of Vijayan and Leatherland (1988) that higher stocking density led to retardation of growth and increase in food conversation ratio. Space constraint appeared to result from higher stocking density which led to higher competition for feed and obvious inadequacy, for even though the same amount of feed was fed to all the treatments, food conversion improved with reduction of stocking density at 5.78, 4.57, 3.95, 3.07, 2.26 and then 2.75 for ponds 1- 6 respectively.

The fish also survived best with the 2.88 fish/m^3 stocking density at 45.45% as against 28.18, 35.45, 37.27, 40.91 and 41.82% for the 6.33, 6.45, 5.05, 3.6 and 2.03 fish/m^3 treatments respectively. The number of off-springs produced, all in progressive sizes increased as the stocking density decreased and more space was made available, this time reaching the highest level at the lowest stocking density of 2.05fish/m^3.

Table 5: Growth performance, feed utilization and survival of the experimental fish

Parameters	**Pond 1 6.3fish/m^3**	**Pond 2 6.45fish/m^3**	**Pond 3 5.05fish/m^3**	**Pond 4 3.6fish/m^3**	**Pond 5 2.86fish/m^3**	**Pond 6 2.03fish/m^3**
Growth Performance:						
Av. Initial body weight (g)	4.33	4.33	4.33	4.33	4.33	4.33
Av. Initial length (cm)	6.06	6.06	6.06	6.06	6.06	6.06
Av. Final weight (g)	59.68^c	74.36^c	85.37^c	108.69^b	146.10^a	120.79^b
Av. Final length (cm)	11.36^b	10.26^b	12.09^b	13.79^a	14.46^a	13.86^a
Av. Weight gain (g)	55.33^c	70.03^c	81.04^c	104.36^b	141.77^a	116.46^b
Av. Gain in length (cm)						
Relative weight gain %	1277.83^d	1617.32^c	1871.59^c	2410.16^b	3274.13^a	2689.61^b
Av. Daily weight gain	0.22	0.26	0.30	0.39	0.53	0.43
Feed Utilization:						
Apparent Feed Consumption (g)	320	320	320	320	320	320
Feed Conversion ratio	5.78	4.57	3.95	3.07	2.26	2.75
Survival Rate:						
No. of fish stocked	111	111	111	111	111	111
No, after 9 months	31	39	41	45	50	46
% Survival	28.18	35.45	37.27	40.91	45.45	41.82
No. of off springs	1530^c	1636^c	1674^c	2053^b	3160^a	3234^a
Cost Benefit Effect:						
1. Cost/kg feed (table 4) (₦)	79.09	79.09	79.09	79.09	79.09	79.09
2. Amount of feed required to produce 1kg fish (FCR) kg	5.78	4.57	3.95	3.07	2.26	2.75
3. Cost Benefit (1 x 2)	457.14	361.44	312.41	242.81	178.74	217.25

a, b… means of the same suffix not significantly different (P>0.05)

This obviously is in line with the findings of Allison *et al* (1979) that the high fecundity of tilapia could be controlled by stocking at high density.

The 2.88 fish/m^3 treatment also provided the cheapest cost of producing 1kg of the fish at ₦178.74 as against the ₦457.14, ₦361.44, ₦312.41, ₦242.81 and ₦212.25 per kg of the 6.33, 6.45, 5.05, 3.60 and 2.05 fish/m^3 treatments respectively. The treatments with the least cost also had the highest survival and incidentally also had the highest number of off-springs. The treatments with the lowest stocking densities had become those with the highest at the end of the day. This proves Dada's (2005) assertion that the higher the stocking densities, the lower will be the production cost, if satisfactory survival and growth are maintained.

CONCLUSION

The study showed that stocking of the tilapia (*O.niloticus)*in earthen pond (mixed males and females) at the low density of 2-3 fish per m^3 space results in better growth performance, production of off-springs and cheaper production cost than at higher densities.

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