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THE GROWTH PERFORMANCE OF *OREOCHROMIS NILOTICUS L*. REARED IN FRESH WATER PONDS LOADED WITH VARYING LEVELS OF POULTRY MANURE

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ABSTRACT: This experiment was conducted to study the effects of different levels of poultry manure loading and stocking density on the growth performance *of Oreochromis niloticus* in ponds. Instantaneous growth rate and total production of groups of fish stocked at a rate of 1 fish/m^2, and 2 fish/m^2 reared in ponds loaded with 0.5 and 1.0 kg poultry manure were studied over a period of 10 months fish culture. A 0 level of manure loading was considered as a control group. The results obtained showed that the groups of fishes from stocking density of 2 fish/m^2 and assigned to the ponds unloaded with poultry manure brought lower mean instantaneous growth rate than the others. Reduction of the stocking density by 50% and loading ponds with poultry manure resulted in improved fish growth performance. The highest mean instantaneous growth rate was recorded from the groups assigned to l kg of poultry manure and stocked at a rate of 1 fish/m^2. However, the highest total fish production (204.54g/m^2) was recorded from the 2 fish/m^2 stocking density raised in ponds loaded with l kg of poultry manure.

Key words/phrases: Growth performance, integrated fish-poultry farming, *Oreochromis niloticus* L., poultry manure loading, stocking density

INTRODUCTION

The Tilapean fishes, which have received considerable attention of many countries due to their good aquaculture potential, are widely distributed in Ethiopia. Among all the species of fish referred by the common name tilapia, Oreochromis niloticus L. is by far the most important. Over the past 30 years, O. niloticus has been distributed throughout the world and became the mainstay of tilapia farming in many countries at all levels ranging from subsistence to highly intensive farming systems. The importance of O. niloticus stems from its relatively fast growth rate, adaptability to a wide range of culture conditions and high market demand. Unfortunately, however, aquaculture operations are greatly limited by the shortage and high cost of commercial feeds and fertilizer required for fishponds (Libunao, 1990).

Several researchers reported the potential feed value of animal waste for livestock (Arndt, *et al*., 1979; Battacharya and Tayler (1975); Smith and Wheeler, 1979) and fish (Schroeder, 1974; Stickney, *et al*., 1977; Wit *et al*., 1997). Following these studies, in which animal manure was used as a feed ingredient, the emphasis changed to one in which it was used as a fertilizer deposited in ponds. McGeachin and Stickeny (1982) found that between 70 and 140 kg/ha/day of dry poultry manure would produce good growth in *Tilapia aurea.* In another study better growth and survival of the walking catfish (*Clarias ishariensis*) was obtained in ponds fertilized with 90 kg/ha/day of poultry waste (Fegbenro and Sydenham, 1988). In addition, Libunao (1990) reported that the growth performance of *O. niloticus* increased with increased goat manure loading but decreased as fish stocking density increased. Such an integrated fish-poultry farming has already assumed greater significance in many countries in view of its role in integrated rural development and recycling organic wastes which otherwise are becoming environmental pollutants (Sinha, 1981; Libunao, 1990).

Ethiopians have a favourable attitude towards poultry and "*Doro Wat*", a spicy dish made from poultry meat and eggs. Household poultry is widely distributed all over the Ethiopian villages and currently, there is rapid expansion of the modern poultry production sector in both urban and semi-urban areas (NPRPS, 1998). However, intensification in poultry production has already been bound to the problem of waste disposal in urban Ethiopia. Thus the integration of aquaculture with poultry farming (*i.e.*, loading fish pond with poultry manure) seems to have significant social, economic and environmental implications.

Since Ethiopia has a great potential for aquaculture development, the initiation of aquaculture seems to be one means of providing cheap animal protein to the Ethiopian people. The current increasing market demand for fish protein in Ethiopia can be met only when the capture fishery is supplemented by aquaculture.

Hence, the major objective of this pond experiment was, to study the effect of different levels of poultry manure loading and stocking density on the growth performance of *O. niloticus* in ponds.

MATERIALS AND METHODS

Description of experimental ponds

The study was conducted in Jimma, 335 km southwest of Addis Ababa, at an altitude of 1700 m. The mean daily temperature and annual rainfall of the study area is 19.15°C and 129.45 mm, respectively (Jimma Meteorological Station). The soils are loamy clay, acidic and low in organic matter content.

A total of twelve experimental ponds, each with an area of 30-meter square and average depth of 75 cm and sloped walls were constructed for the study. Pipes of 10 cm diameters were fitted to each pond to be used as water inlet and overflow. A screen of mesh wire (2 mm) was fixed to each of the water inlet and overflow pipes to prevent the entrance of wild fish and escape of experimental fish. A layer of fertile soil (top soil) was spread over the surface of the bottom of the pond to promote pond soil fertility. The study site was fenced with mesh and barbed wires to keep out predators. Each pond was filled with adequate water from Aweitu River. More water was added to each pond twice a day throughout the study period to compensate for water lost by seepage and evaporation.

Experimental design

First a total of 180 juvenile *O. niloticus L.* were randomly selected and divided into six groups of 30 fishes each, with initial group (mean) weight and length ranging between 6.23-6.93g and 6.62-6.87 cm, respectively. Each group was randomly stocked to one of the six experimental ponds and randomly assigned to one of the two treatments, namely 0.5 and 1 kg of poultry manure loaded every other day and to the control group. These represented a stocking density of 1 fish/m^2. In a similar way a group of 60 fish (2 fish/m^2) were introduced to the remaining six experimental ponds and randomly assigned to the control and one of the two levels of poultry manure loading. Thus, three levels of poultry manure loading and two different stocking densities were studied using completely randomised design with two replications.

The poultry manure (of layers leghorn chicks) used in the study was obtained from the poultry farm of Jimma College of Agriculture. The composition of the manure was 23% crude protein, 69% organic matter, 85.3% dry matter, and 30% ash determined according to the proximate method of Analysis (AOAC, 1955).

Growth performance of treatments was compared using parameters such as instantaneous growth rate and total production.

Sampling and measurements

Fish were sampled monthly from December 1998 to September 1999 using 10 m long beach seine with 0.6 mm stretched mesh. Sample size used comprised 19–30 and 43–60 fish for the 30 and 60 fish stocking densities, respectively. Body weights were measured using beam balance and total length was measured using measuring board. During each sampling occasion fish were caught, measured and returned to the ponds.

Total length was expressed as the distance from the tip of the snout to the end of the caudal fin. Instantaneous growth rate was calculated using the formula:

$$\ln(\text{final size}) - \ln(\text{initial size}) / \triangle t$$

Total production was determined using the formula:

$$P = G \times B = \ln(\text{size final}) - \ln(\text{initial size}) / \triangle t \times (N_{final} \times W_{final}) \times (N_{initial} \times W_{intial}) / 2$$

RESULTS AND DISCUSSION

Effects of poultry manure and stocking density on growth performance of **O. niloticus**

The parameters used in this study (such as instantaneous growth rate and total production) are summarized values for which standard error values cannot be computed. Therefore, differences of statistical significance between treatments were not possible to establish.

The growth performance of the groups of experimental fish assigned to different rates of poultry manure and fish stocking densities are shown in Table 1 and Figures 1, 2 and 3. The growth curves of the three-manure loading rates (Figs 1 and 2) show better performance in growth per fish for the highest level of manure loading. On the other hand, the bar graphs of the two stocking densities (Fig. 3) show that fish in the denser ponds (*i.e.*, 2 fish/m^2) gained more weight and length than their counterparts in the lower density ponds. Consequently, total production of more densely stocked ponds were about one and a half times as high as those of the less densely stocked ponds (Table 1).

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Table 1.. Growth performance of the experimental fish placed in ponds loaded with different levels of poultry manure at two different stocking densities.

	30 fish stocking density Treatments			60 fish stocking density Treatments		
	T_1	T_2	T_3	T_4	T_5	T_6
Mean initial length (cm) ±S.E	6.86 ± 0.13 n = 60	6.87 ± 0.02 n = 60	6.85 ± 0.12 n = 60	6.71 ± 0.08 n = 120	6.69 ± 0.08 n = 120	6.62 ± 0.08 n = 120
Mean final length (cm) ±S.E	15.44 ± 0.2 n = 52	17.08 ± 0.34 n = 53	18.7 ± 0.37 n = 52	15.18 ± 0.16 n = 97	16.93 ± 0.19 n = 95	16.95 ± 0.17 n = 97
Mean initial weight (gm) ± S.E	6.93 ± 0.29 n = 60	6.91 ± 0.24 n = 60	6.91 ± 0.32 n = 60	6.45 ± 0.15 n = 120	6.35 ± 0.21 n = 120	6.23 ± 0.22 n = 120
Mean final weight (gm) ± S.E	68.5 ± 1.87 n = 52	107.24 ± 5 .33 n = 53	144.58 ± 7.71 n = 52	62.55 ± 2.14 n = 97	93.05 ± 3 n = 95	105.66±3.04 n = 97
Instantaneous Growth rate	1.008	1.14	1.2	0.98	1.12	1.116
Production (gm/m²)	66.83	115.87	138.1	111.74	179.23	204.54
Mortality during the study period	13.3 %	11.7 %	13.3 %	19.2 %	20.8 %	19.2 %

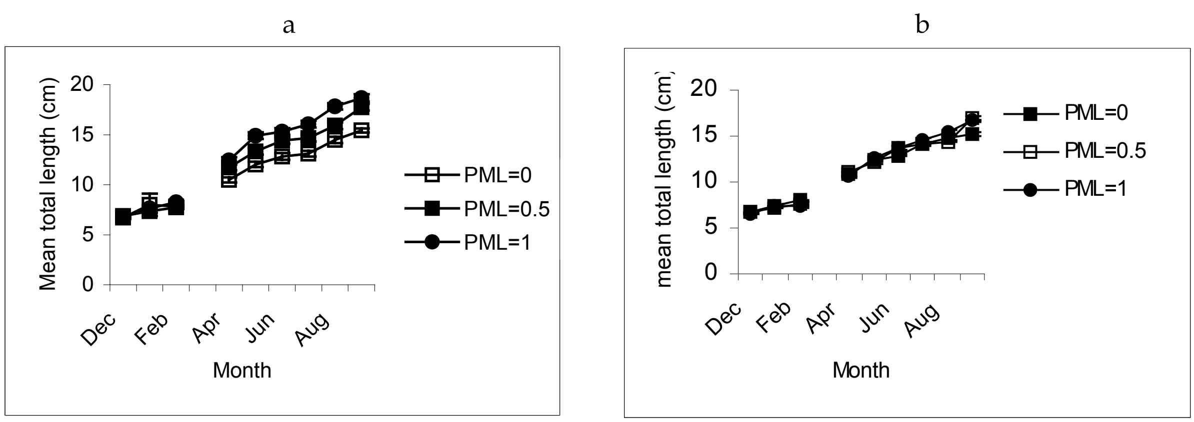

Fig. 1. Growth in length of *O. niloticus* with varying levels of poultry manure loading (PML):
a) Fish stocking density (FSD) = 1 fish/m², b) Fish stocking density (FSD) = 2 fish/m².

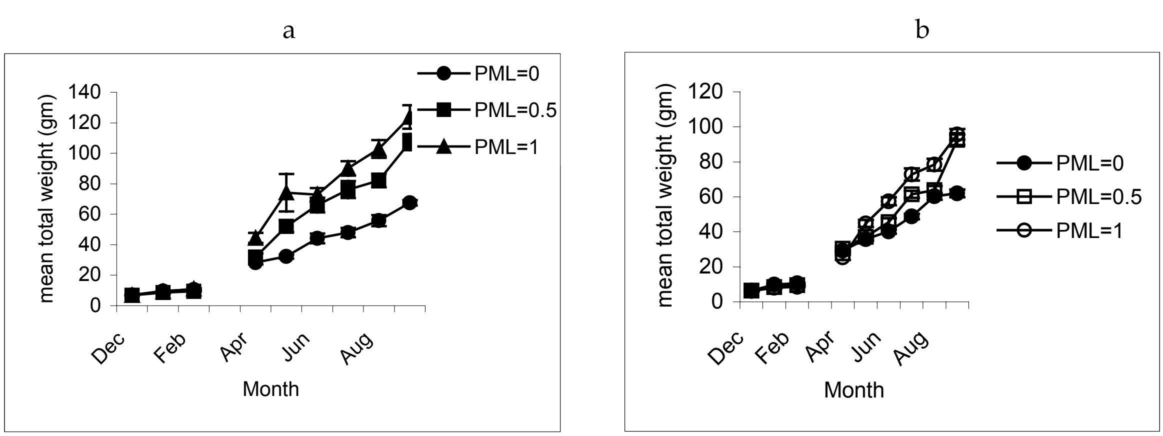

Fig. 2. Growth in weight of *O. niloticus* with varying levels of poultry manure loading (PML):
a) Fish stocking density (FSD) = 1 fish/m², b) Fish stocking density (FSD) = 2 fish/m²

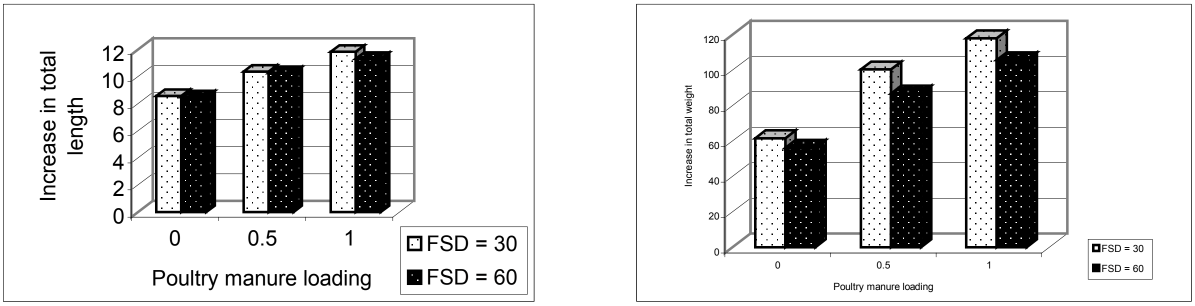

Fig. 3. Effect of stocking density at different levels of poultry manure loading on mean increase in total length and total weight at the end of the experimental period.

Along the same stocking density fish raised in ponds receiving poultry manure showed better growth as measured by instantaneous growth rate than those raised in ponds receiving no poultry manure. The highest growth rate (1.2cm/month) was obtained from the groups of fish stocked at a rate of 1 fish/m^2 and placed in ponds that received the highest rate of poultry manure. Growth rate decreased when the level of poultry manure loading was decreased. The lowest growth rate (0.98cm/month) was recorded from group of fish in the control ponds that were not loaded with poultry manure and stocked with 2 fish/m^2. The results of this study agree with that of Libunao (1990) who reported the best growth from groups of *O. niloticus* assigned to the highest level of goat manure loading in the Philippines. The growth rate of fish assigned to ponds that received poultry manure was markedly greater than the growth rate reported for the same species in natural waters. Yosef Tekle Giorgis (1990) and Kebede Alemu (1995) reported that *O. niloticus* could attain lengths of 8.3 cm and 9.5 cm in Lakes Awassa and Hayq, respectively, over a period of one year. These values approximate growth rates of 0.69 and 0.79 centimetres per month, respectively. According to Stickeny (1994) the high level of nutrients released from manure oxidation could support the growth of extensive phytoplankton. Therefore, the better growth performance of *O. niloticus* that resulted from increased level of poultry manure loading possibly indicates that natural food produced by manure is being efficiently utilized by fish biomass.

The growth trends of the two stocking densities studied showed an inverse relationship between fish growth and number of fish per unit area of pond. A slight advantage in fish growth was evident for the 30-fish stocking density (Fig. 3). According to Libunao (1990) *O. niloticus* raised in ponds stocked at a rate of 1 fish/m^2 grew better than those stocked at a rate of 2 fish/m^2. Results from another study indicate that the availability of food is a limiting factor for growth of tilapia species. At high stocking rates of ponds, both individual size and total production rises with increase of food supply while under same food supply growth rate decreases as the stocking rate increases (Lingen, 1959). However, Cridland (1960) from the preliminary trials he conducted to study the effect of crowding on *Tilapia esculenta* reported that the high population density need not have any deleterious effect on growth rate.

In the present study the total production obtained from the different groups varied from 66.8 to 204.5g/m^2 (Table 1). Total production increased with increasing rate of poultry manure loading and fish stocking density. The highest production (204.5 g/m^2) was recorded from the groups assigned to ponds loaded with 1.0 kg of poultry manure and stocking density of 2 fish/m^2. The lowest production (66.8g/m^2) was recorded from the groups assigned to ponds that did not receive any manure. Within the same rate of poultry manure loading, total production brought by stocking density of 2 fish/m^2 was higher than those brought by 1 fish/m^2 stocking density by about 48.2–67%. Similar results were reported by Libunao (1990) where densely populated ponds produced better yields than scarcely populated ones. However, the highest production of *O. niloticus* obtained in the present study seemed to be greater when compared to the best yield (1170 kg/ha) reported by Libunao. This is possibly because a longer culture period was used in the current study.

In conclusion, the results of this study showed that loading fishpond with poultry manure and reducing stocking density by 50% resulted in improved growth performance. However, total production increased with increasing poultry manure loading and fish stocking density. Though integrated fish-poultry farming seems to be economically viable and environmentally friendly, further studies are required in the area of determining the optimum level of stocking density and poultry manure loading. In addition, since fish were caught, measured and returned to the ponds during each sampling occasion repeated handling of fish may have affected growth but this was not ruled out.

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