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Comparative growth performance of monosex and mixed sex Tilapia (*Oreochromis niloticus*)

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Abstract
Tilapia (*Oreochromis niloticus*) is a popular culture fish due to its economic importance. The basic problem of aquaculture however, is that a mixed sex, freely breeding Tilapia population reach sexual maturity early and start reproducing in grow-out ponds before they reach a marketable size, reducing the yield and value at harvest. Therefore, commercial production of Tilapia often relies on monosex culture of males. Growth evaluation of monosex and mixed sex is often required to convince farmers that the monosex culture is superior with respect to growth, yield and environmental concerns. Comparative growth experiment of mixed sex and MT hormone induced monosex Tilapia was conducted at RARS, Tarahara during August 2016 to January 2017 for a period of 150 days. Tilapia fry of monosex and mixed sex (mean weight 3.45±0.35 g) was stocked in respective triplicate hapas (3x2x1 m^3 each) established in an earthen pond (0.2 ha). The stocking density maintained was 50 fish/m^2 for the first 90 days and later stocking density reduced to 10 fish/m^2. The stocked fish were fed with a pelleted ration containing 27% crude protein. The feeding rate was adjusted according the size of fish, 5% at the beginning to 3% at harvest. Water temperature (17-33 ºC), dissolved oxygen (3.9-9.0 mg/L) and pH (7.2-8.6) all were within favorable range for fish culture. The growth of monosex Tilapia was significantly higher (p<0.05) compared to mixed sex Tilapia in all monthly growth check. Harvest weight of monosex and mixed sex Tilapia was 133.7 g and 101.5 g, respectively and the difference was significant (p<0.05). The size (length) of fish was also significantly larger (p, 0.05) for monosex compared to the mixed sex Tilapia. The relationship of fish lengths and weights expressed by power function revealed that the slope of the length weight regression lines was normal for monosex (2.94) and mixed sex Tilapia (2.84) with the high correlation coefficient (>0.9). The present findings indicated that monosex Tilapia had high growth rate with better shape and size over the mixed sex Tilapia.

Keywords: Tilapia, monosex, mixed sex, growth, size

Introduction
Tilapia (Oreochromis niloticus) is the second largest group of cultural freshwater fish after the carps in the world (Pompa and Lovshin, 1996) [1]. It is a native African species tolerates a wide range of environmental conditions and in many parts of the world, particularly in tropical and sub-tropical countries (Dagne *et al.,* 2013) [2]. They are often dubbed as “aquatic chicken and “poor men’s fish and play a significant role in the livelihood by supplying cheap protein (Bhujel, 2012) [3].

One of the major constraints of tilapia farming with mixed-sex population is inherent high reproductive capacity resulting from early maturity, highly developed parental care, and multiple spawning cycles. Under favourable conditions they will continue to reproduce, the offspring competing with the initial stock for food, resulting in stunted growth and unmarketable fish (Phelps and Popma, 2000) [4]. Male tilapia grow significantly faster, larger and more uniform in size than females (Bwanika *et al.,* 2007) [5]. The desirability of monosex male populations of tilapia is well established for increased production potential and low management requirements (Pillay, 1993) [6]. Hormonal sex reversal is a technique of changing of sexes from one sex to another infish by administering synthetic steroid hormones and hormonal sex reversal of tilapia has been an active area of research for the past three decades (Pandian and Varadaraj, 1988) [7]. The direct masculinization of tilapias using hormone is the most common method for monosex male production (Shelton *et al.* 1978) [8]. Thus, the objective of present study was to compare and evaluate the growth and yield performance of mono sex and mixed sex tilapia.

Materials and Methods

The experiment of mixed-sex and MT hormone induced mono sex tilapia was conducted at RARS, Tarahara during August 2016 to January 2017 for a period of 150 days. The growth experiment of mono sex and mixed sex as treatments was conducted in completely randomized design (CRD) with three replicates. Tilapia fry of mono-sex and mixed sex (mean weight 3.45±0.35 g) was stocked in respective triplicate hapas (3x2x1 m^3 each) established in an earthen pond (0.2 ha). The stocking density maintained was 50 fish/m^2 for the first 90 days and later stocking density reduced to 10 fish/m^2. The stocked fish were fed with a pelleted ration containing 27% crude protein. The feeding rate was adjusted according the size of fish, 5% at the beginning to 3% at harvest. Monthly growth check was carried out by sampling 20% of the standing biomass. Sample fish biomass were netted monthly for growth check. Water quality parameters: temperature (daily), dissolved oxygen (DO) and pH were measured at weekly interval to correlate the growth of fish with their rearing environment.

Statistical Analysis

Data processing and illustrations were performed using Microsoft excel. Differences between treatments were analyzed with Student t-test using SPSS ver. 20.

Result and discussion

The growth of mono sex Tilapia was significantly higher (p<0.05) compared to mixed sex Tilapia in all monthly growth check. The study showed harvest weight of mono sex and mixed sex Tilapia was 133.7 g and 101.5 g, respectively. Githukia *et al.* [9] 2015 reported that average weight of male monosex and mixed sex fishes was 200.8±0.81 g (mean ± SE) and 123.4±0.76 g, respectively. Little *et al.* [10] 2003 reported that mono sex fishes reached a larger final individual size (128.8±6.8 g) than mixed sex fishes (112.8±14.6). Similarly, Chakraborty *et al.* [11] 2011 also reported that mono sex tilapia showed significantly higher i.e weight (243.33±5.88 g), length (22.92±0.2), DWG (1.35±0.06), SGR (5.25±0.04) than mixed-sex i.e weight (75.72±1.7 g), length (16.49±0.3), DWG (0.42±0.02), SGR (4.6±0.05).

Table 1: Weight gain of mono sex and mixed sex tilapia at different time interval

Growing day	Weight, g		Length, cm	
	Mono sex	Mixed sex	Mono sex	Mixed sex
1	1.7±0.4^a	1.3±0.4^b	4.7±0.5^a	4.3±0.6^b
30	5.8±1.6^a	4.1±1.5^b	7.4±0.7^a	6.1±1.1^b
60	92.1±37.6^a	14.9±11.7^b	19.3±2.7^a	10.7±3.1^b
90	126.6±48.1^a	22.9±12.9^b	21.1±2.5^a	12.1±2.5^b
120	92.8±3.14^a	78.5±3.85^b	24.0±4.1^a	14.5±3.4^b
150	133.7±5.43^a	101.6±2.13^b	35.2±3.5^a	22.2±3.9^b

Different superscripted letters within row are significantly different at α0.05.

This study showed the stocked fish were fed with a pelleted ration containing 27% crude protein. The feeding rate was adjusted according the size of fish, 5% at the beginning to 3% at harvest. The result of this experiment was monosex tilapia had high growth rate with better shape and size over the mixed sex Tilapia. Sule[12], 2004 reported that the similar feeding diet, the mean total weight increase for the all-male *Oreochromis niloticus* was 206.0±1.3 g and that of the female was 170±1.0 g while that of the control (Mixed population) was 132.0±0.8 g respectively.

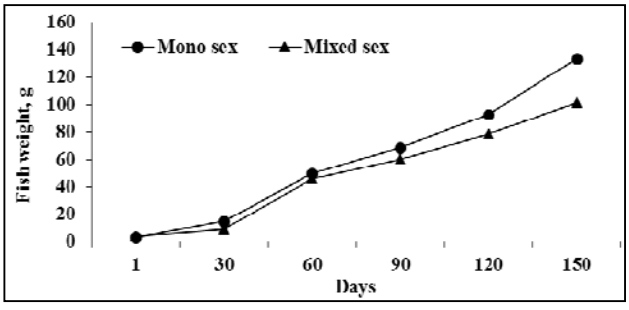

Fig 1: growth trend of mono-sex and mixed- sex tilapia in during the experimental period.

This study also showed Water temperature (17-33 ºC), dissolved oxygen (3.9-9.0 mg/L) and pH (7.2-8.6) all were within favorable range for fish culture. Maximum feed consumption rate at 22 ºC is only 50 to 60% as great as at 26 ºC. Tilapia reportedly tolerates temperatures up to 40 ºC (Yadav, 2006) [13]. The relationship of fish lengths and weights expressed by power function revealed that the slope of the length weight regression lines was normal for monosex (2.94) and mixed sex Tilapia (2.84) with the high correlation coefficient (>0.9).

The size (length) of fish was also significantly larger (p, 0.05) for mono sex compared to the mixed sex Tilapia. Hopkins [14] 1992 suggest that slope of the length weight regression line when applying power function should have values between 2.5 to 3.5 with the high correlation coefficient (>0.9) for aquaculture fish species (Hopkins, 1992). Githukia *et al.* [9] 2015 reported that average length of male monosex and mixed sex was 22.4±0.21 cm and 18.6±0.23 cm, respectively. Sule [12], 2004 also reported that the mean increase in length for the all-male and all-female *Oreochromis niloticus* were 2.6±0.3 cm and 1.8±0.1 cm respectively.

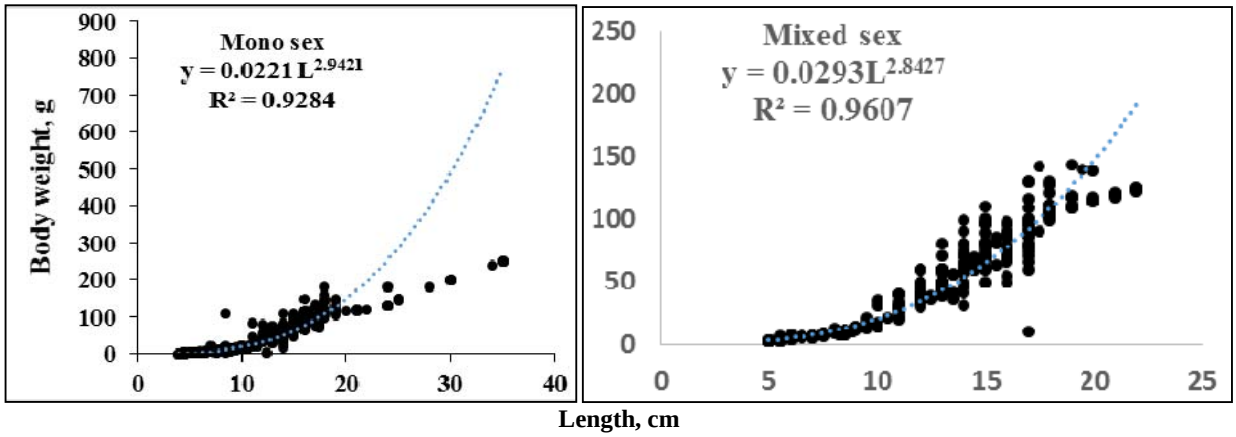

Fig 2: Condition co-efficient of Mono sex and Mixed sex Tilapia

Conclusion

The present findings indicated that mono-sex tilapia had high growth rate with better shape and size over the mixed sex Tilapia.

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