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Genetic improvement of tilapias in China: Genetic parameters and selection responses in growth of Nile tilapia (*Oreochromis niloticus*) after six generations of multi-trait selection for growth and fillet yield

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ABSTRACT

Genetic parameters and selection responses were obtained for growth of Progift Nile tilapia (*Oreochromis niloticus*) in China after six generations of multi-trait selection. About 64,000 tagged fingerlings representing 787 full-sib families in seven generations of Nile tilapia originating from the GIFT breed were tested in freshwater earthen ponds, floating cages in reservoirs and a brackish water earthen pond in Guangdong and Hainan Provinces of China. Individual body weight was recorded on 25,000 of these at the expected time of sexual maturation and 50,000 at harvest to estimate genetic parameters for growth rate. Heritability (h^2) estimates for body weight showed large variation in magnitude (0.00–0.52) when analyzing data from each test environment and generation separately. Estimates obtained in floating cages and a brackish water pond was comparable or lower in magnitude than those obtained in freshwater earthen ponds. The h^2 estimates for body weight at harvest became more stable (range 0.13–0.20) when data from previous generations were included in the analysis. Including all data, the effect common to full-sibs (c^2) accounted for 10% of the total phenotypic variance for body weight at harvest. Genetic correlation between growth recorded at expected time of sexual maturation and at harvest was 0.8, but seemed to decrease in later generations. The genetic correlations between growth in freshwater earthen ponds and other test environments were of similar magnitude. Breeding candidates in the base population (G_0) were ranked according to their individual breeding values for growth (recorded as body weight at harvest), while those in later generations (G_1–G_5) were ranked according to a selection index including individual breeding values for growth and family breeding values for fillet yield. The selection response for growth was, on average, 11.4% per generation of selection (range 7.4–18.7%) when estimated based on control groups representing the parental generations. A genetic trend analysis based on all data ($h^2 = 0.20$, $c^2 = 0.10$) predicted an accumulated selection response of more than 200 g and an average selection response of 8.0% per generation of selection when using the LS mean of the G_0 as a base line for the comparison. The average inbreeding coefficient (F) was estimated to be 5.0% after six generations of selection. The results are discussed in a practical context of developing selective breeding programs for tilapias and it is concluded that the ongoing selective breeding of Nile tilapia in China has resulted in considerable genetic improvement of growth (60–90% larger body weight at harvest) after six generations of multi-trait selection.

1. Introduction

Tilapias have the potential of becoming the most important aquaculture species in the world. In 2010, the world production of farmed tilapias reached 3.2 million metric tons of which about 35% was produced in China (Fitzsimmons et al., 2011). The Chinese tilapia production increased very rapidly during a 20-year period until 2005 when the annual production reached about one million metric tons (Li et al., 2006; Zhao, 2011). In recent years, however, the tilapia production has stagnated in China due to problems related to unstable climatic conditions (i.e. cold winter temperatures, drought etc.) and disease outbreaks.

In the past, most of the farmed tilapias in China (60–70%) were hybrids produced by crossing Nile tilapia (*Oreochromis niloticus*) females and Blue tilapia (*O. aureus*) males (Li et al., 2006). These hybrids were preferred due to a high male percentage (Lovshin, 1982) and better survival at low water temperatures (Chervinski, 1982). In recent years, China has received several imports of genetically improved Nile tilapia (all originating from the GIFT project in the

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