

Genetic Improvement of Tilapia for Africa at the World Fish Center

Abbassa, Egypt, 2001

Background and Justification

Culture of tilapia in Africa is based mostly upon unimproved populations of Nile tilapia (*Oreochromis niloticus*). In contrast, through the program on Genetic Improvement of Farmed Tilapia (GIFT), ICLARM – The World Fish Center has demonstrated that simple selection for faster growing fish can yield significant increases in growth of tilapia in Asia and these improved fish are now being used widely there. As a result it is believed that substantial improvements in aquaculture production in Africa can be achieved through similar selection for faster growing fish.

Transfer of the improved strains from Asia has not been undertaken because of concern over the potential adverse impact on native germplasm in Africa and unknown effects of gene-environment interactions. The approach being adopted by the Center has therefore been to adapt the technology demonstrated in Asia for use in the genetic improvement of tilapia in Africa, test other approaches, and study the potential environmental consequences of genetically modified stocks. The present report describes progress on this work at the Center's regional research facility in Abbassa, Egypt in 2001.



GIFT Nile tilapia (top), local Nile tilapia strain (bottom) after three months of culture

Objectives

- Produce genetically improved tilapias for aquaculture.
- Identify appropriate methods of tilapia breeding for Africa, notably by comparing mass selection, family selection, and marker-assisted selection procedures to produce improved tilapia for aquaculture.
- Develop an approach to evaluate the potential ecological impacts of alien species and genetically modified stocks.

2001 Results

- **Mass selection.** From the first generation of *Oreochromis niloticus* and *O. aureus* produced in 1999, random (control population) and largest 10% (selected population) males and females were reproduced and the performance of their progeny tested in earthen ponds. These experimental fish were harvested in April 2001. Average body weight of the selected population of *O. niloticus* was 20% higher than that of the control population. However significant improvement was not evident in blue tilapia *O. aureus*. For both *O. niloticus* and *O. aureus* selection



Nile tilapia fry.

was continued. From the fish harvested in April 2001 random (control) and largest 10% (selected) males and females were reproduced, and the performance of their progeny is currently being evaluated in earthen ponds. Data collected to date suggest that improvement in average body weight of the selected *O. niloticus* group over the control group has continued. Final harvesting data will be available at the end of the growth period in April 2002.

- **Combined family selection.** Reciprocal crossbreeds between four Egyptian stocks of *O. niloticus*, were produced with equal contribution of all baseline stocks. In 2001 individual fish were tagged and their performance evaluated communally in an earthen pond. Based on the results, genetic correlations and the heritability value were estimated and the breeding value for each individual was calculated. These individuals are currently being overwintered and conditioned for the next breeding cycle. Blood samples will be collected for DNA analysis and identification of markers.

- **Combined family selection under low input conditions.** A new project has been initiated in collaboration with Wageningen University, the Netherlands. This will establish a new line of *O. niloticus* selected for higher growth under low input conditions and compare its performance with the population selected under higher input conditions. For the project two PhD students from sub-Saharan Africa have been identified and field activities will start in 2002.
- **Environmental risk assessment.** Based on initial work conducted in 2000, a pre-proposal has been prepared. As soon as the proposal is finalized, it will be submitted for funding.
- **Establishment and maintenance of tilapia germplasm.** Four populations of *O. niloticus* from Egypt and two stocks from Kenya and Cote d'Ivoire are being maintained, together with two crossbreeds and two mass-selected lines. Populations of *O. aureus*, *Sarotherodon galilaeus*, and *Tilapia zillii* are also being maintained.

Activities 2002

- Based upon results of selection and testing in 2001 the mass selection programs in *O. niloticus* and *O. aureus* and family selection in *O. niloticus* will be continued.
- In collaboration with Wageningen University selection under low input aquaculture conditions will be initiated.
- Support will be provided to the Egyptian Central Laboratory for Aquaculture Research (CLAR) for adoption of the GIFT technology developed by the Center. It is hoped that this will lead to the initiation of a national breeding program for tilapia in Egypt.
- Fish from the combined family selection program will be used to obtain blood samples for analysis and identification of biochemical genetic markers. This will provide the basis for subsequent work on marker assisted selection.

Tagged Nile tilapia.



ICLARM – The World Fish Center Staff

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Collaborating Institutions

Central laboratory for Aquaculture Research (Egypt), Auburn University (USA), Wageningen University (The Netherlands).



Hapa net cages used for breeding Nile tilapia.



Catching juvenile tilapia for sampling

Publications Journal Articles (refereed)

Rezk, M. A., Kamel, E. A., Dunham, R. A., Ramadan, A.A. 2001. Comparative Growth of Egyptian Tilapias in Response to Declining Water Temperature. *Aquaculture* (in press).

Conference Papers Presented

Rezk, M. A., Kamel, E. A., Dunham, R. A., El-Gamal, A. A., Ramadan, A. A., 2001. Production, survival, seinability, and feed conversion ratios of Egyptian tilapias under a regime of decreasing pond water temperature. In: *Aquaculture 2001, The International Triennial Conference of the World Aquaculture Society, 21-25 January 2001, Florida, USA. Book of abstracts*, p. 550.

Advisory Services and Training

Kamel E. A. 2001. Characterization of tilapia species (Lecture). A training program on: Improving fish farm management. Organized by ICLARM – The World Fish Center and the Multi Sector Support Program, MSSP, of the European Community, Abbassa, Egypt, 20 – 24 February 2001. Trainees were 16 fish farmers from 3 Egyptian governorates with pioneering commercial aquaculture activities.

Kamel, E. A. 2001. Characteristics of tilapia species (Lecture). Training program on: Enhancing sustainable aquaculture production. Organized by ICLARM – The World Fish Center and FAO (Regional Office for the Near East). Abbassa, Egypt, 13 - 22 October 2001. Trainees were 13 participants from 12 Near-East countries.

Rezk, M. A. 2001. Genetics for improving aquaculture production (Lecture). Training program on: Improving fish farm management. Organized by ICLARM – The World Fish Center and the Multi Sector Support Program, MSSP, of the European Community. 20 – 24 February 2001. Abbassa, Egypt. Trainees were 16 fish farmers from 3 Egyptian

governorates with pioneering commercial aquaculture activities.

Rezk, M. A. and Kamel, E.A. 2001. Transfer of the GIFT breeding technology from the Philippines to sub-Saharan Africa and Egypt, a training program (Lectures and field sessions). Organized by ICLARM – The World Fish Center and the GIFT Foundation International. GIFT Foundation International, Munoz, Philippines, 13 – 25 March 2001. Trainees were 15 research personnel from 5 African countries and Malaysia.

Rezk, M. A. 2001. Principles, techniques and applications of Fish Genetics (Lectures). Annual International Training Program in Aquaculture; organized by the Egyptian International Center for Agriculture, Ministry of Agriculture. Cairo, Egypt. February – April 2001. Trainees were 20 fish and aquaculture specialists from about 15 countries in Africa, Asia, and Latin America.

Rezk, M. A. 2001. Genetically sound fish hatchery practices (Lecture). Training program on: Enhancing hatchery productivity. Organized by ICLARM – The World Fish Center and the Multi-Sector Support Programme, MSSP, of the European

Community. Abbassa, Egypt, 26-30 August 2001. The program involved 19 participants from 3 Egyptian governorates leading in commercial aquaculture.

Rezk, M. A. 2001. Role of genetic improvement in aquaculture (Lectures). Training Program on: Enhancing Sustainable Aquaculture Production. Organized by ICLARM – The World Fish Center and FAO (Regional Office for the Near East), 13 - 22 October 2001. The program involved 13 participants from 12 Near-East countries.

Conferences and Workshops

Kamel, E. A. 2001. Meeting of Asia-Pacific Group of Fisheries and Aquatic Research, GoFAR. 26 – 29 March 2001. Penang, Malaysia.

Rezk, M. A. 2001. The International Triennial Conference of the World Aquaculture Society, 21-25 January 2001, Florida, USA.

Rezk, M. A. 2001. International Network on Genetics in Aquaculture, INGA. Seventh Steering Committee Meeting. 7 – 11 May 2001. Hanoi, Vietnam.



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