The GENEDAT Table in FishBase

This table aims to assist the application of genetics to fish breeding, and thus contains records of heritabilities and responses to selection. The genetic improvement of farmed fish requires breeding programs to enhance traits of high economic importance (such as growth rate, age at maturity, carcass quality and many more; see also Box 1 on 'Selective breeding of Nile tilapia'). The fields of this table are:

Fields

Locality and Country: Refer to the site where the experiment was done.

Trait: Pertains to the desirable phenotypic character for improvement by selective breeding. The choices include: growth rate; age at first maturity; size at first maturity; egg number; egg size; egg weight; egg survival; larval survival; disease resistance; behavior; resistance to environmental factors; dressing weight; carcass quality; fat content; protein content; food conversion; anatomical modification color and other. Traits not included here are mentioned in the **Comment** field.

Box 1. Genetic Improvement of Farmed Nile tilapia.

By the 1980's, Nile tilapia (*Oreochromis niloticus*) had become the most widely farmed tilapia species. Pullin and Capili (1988) found that little attention had been given to the genetic improvement of its farmed populations and that broodstocks outside Africa had been derived from very small founder populations and had probably been mismanaged, with consequent genetic drift, inbreeding depression, and introgressive hybridization with other species, notably *O. mossambicus*. An international workshop confirmed the wealth of tilapia genetic resources in Africa, the limited genetic diversity of tilapia broodstocks used for aquaculture outside Africa, and the need for more investment in research for the genetic improvement of tilapias (Pullin 1988).

ICLARM, in consultation with colleagues from AKVAFORSK, Norway, who had pioneered the selective breeding of farmed salmon (Gjedrem 1985) and from the Philippine Bureau of Fisheries and Aquatic Resources and the Freshwater Aquaculture Center of Central Luzon State University, Philippines, secured funding from the United Nations Development Programme (UNDP) for the Genetic Improvement of Farmed Tilapias (GIFT) project. With the help of many colleagues and institutions in Africa, Asia and Europe, four new wild founder populations of Nile tilapia (from Egypt, Ghana, Kenya and Sénégal) and populations of four strains of Nile tilapia in current use by farmers in Asia ('Israel', Singapore, Taiwan, and Thailand) were assembled, after strict quarantine, in the Philippines. Their performance was compared in 11 different farm environments. Some wild African strains grew as well or better than Asian farmed strains. A complete 8 x 8 dialle crossbreeding experiment, to compare the performance of all 64 possible hybrids among these strains, showed no substantial heterosis (hybrid vigor) and the GIFT project team therefore decided to pursue a strategy in which genetic material from the best families of all strains would be incorporated, according to their performance rankings, in a synthetic strain. This synthetic strain was subjected to selective breeding for good growth.

The Asian Development Bank (ADB) supported a follow-up project: Dissemination and Evaluation of Genetically Improved Tilapias in Asia (DEGITA). The yield potentials of GIFT strains were shown to be significantly higher than those of some of the existing farmed strains in Asia, though there were some variations; for example, improvements were about 54% in Vietnam and 97% in Bangladesh (ICLARM-ADB 1998). In 2003, an ADB team, including the WorldFish Center, evaluated the overall impacts of the GIFT and DEGITA projects and estimated that the economic

internal rate of return on investments in GIFT development and dissemination was more than 70% from 1988 to 2010, with an estimated net presnt value of US$368 million at constant 2001 prices (ADB 2005). A researcher at the University of British Columbia (Bozynski 1998) found that although the GIFT team selected fish for fast growth, they also, in this process, selected quietly behaved fish. This fits with the history of agriculture, in which docility has been one of the most important attributes for domestication. Quiet fish grow faster and their low aggression lessens some environmental risks.

References

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Mean: Refers to the average value of the investigated trait.

Unit: Pertains to the unit of measurement of the trait (e.g., g, weeks, mm).

S.D.: Refers to the standard deviation from the mean of a given trait.

C.V.: Refers to the coefficient of variation of the investigated trait, defined by the formula **C.V. = S.D./mean.**

Heritability (h^2): Refers to the proportion of additive genetic variance in the total phenotypic variation, i.e., will the trait be expressed or passed on to the offspring? If a trait is sufficiently heritable, selective breeding is likely to be very effective. However, if $\mathbf{h^2}$ is low, i.e., close to zero, environmental factors have caused most of the variation and therefore little genetic gain can be obtained by selection.

S.E.: Refers to the standard error of the mean of heritability.

Method: Refers to the method used to estimate heritability. The choices are: sib analysis; offspring/parent regression; realized heritability; others. Methods not included here are mentioned in the second **Comment** field.

Selection studies: Indicates whether a selection study has been performed.

Response %: Gives the response to selection expressed as a percentage.

Method: Refers to the method of selection. The choices are: mass selection; individual selection; sib selection; family selection; within family selection; index selection and tandem selection; others. Methods not included here are mentioned in the third **Comment** field.

Status

To date, about 200 records for 9 species and strains have been entered. The information was obtained from references such as Gjedrem (1983), Gjerde (1986) and Tave (1988).

Internet

The GENEDAT table is not yet available on the web.

References

Gjedrem, T. 1983. Genetic variation in quantitative traits and selective breeding in fish and shellfish. Aquaculture 33:51-72.

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Cite as:

Casal, C. and L. Agustin. 2011. The GENEDAT table in FishBase. In: Froese, R. and D. Pauly. Editors. 2011. World Wide Web electronic publication, www.fishbase.org, version (06/2011).

Last updated on 14 July 2010. Previous authors of 1998 and 2000 versions were Christine Casal and Liza Agustin.