

## CONTRIBUTION OF GENETIC IMPROVED STRAINS TO CHINESE TILAPIA INDUSTRY

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### **Abstract**

In China, the tilapia industry, including of 121 million tons aquaculture production, and 170 000 tons exporting proceeded tilapia products, near 1 million labors, near 20-30 aquafeed manufactures and hundreds trading company, has been established. Good seeds is a key issues for the Temitope succeed and sustainable development of tilapia industry.

Introduction of *Oreochromis mossambicus* has been not accepted as a cultured species because poor performance, but it hinted us to looking for better species of tilapias. The most successful introduced species is Nile tilapia, but usually the introduction was based on small founder population following poor management in brood stock, plus frequent moving of fish, accidental mixing of stocks, and unconscious selection, caused inbreeding, introgression, finally resulted poor growth, early maturation, low production, low fillet, and low profit. Good strains and good management of brooders and seeds is the most critical factor to the development of tilapia industry.

Under the support by ADB and cooperation of ICLARM (now World FishCenter) GIFT strain of Nile tilapia (*Oreochromis niloticus*) was introduced into China in 1994 at its 3rd generation. It was found that it has some advantages (such as fast growth) but also some disadvantages (such as not stable in performance) by a detailed evaluation in three major agro-ecosystems in China from 1994 to 1996. We use the GIFT tilapia as base population, through over 10 years and 9 generations selection, the NEW GIFT was produced and certified by the National Certification Committee of Aquatic Wild and Bred Varieties (NCCA WV) as a new variety. The major characters of NEW GIFT strain include: (1) Fast growth, uniform size, (2) Better body shape, higher fillets ratio, (3) Nice stripe pattern on caudal fin, good for farmers to recognize, (4) High genetic purity, (5) With two SCAR makers<sup>5</sup>. At present the NEW GIFT has been extended into over 20 provinces, and becomes a principle stock in tilapia industry of China, forms a significant social benefit and economic benefit.

**Key words:** genetic improved strains, NEW GIFT Nile tilapia, tilapia industry

## INTRODUCTION

Tilapias have a high reproduction capacity, fast growth, extensive feeding, high resistance in disease, therefore they have been recommended by the FAO to be a good culture species. At present it has been cultured in 85 countries/areas. After the Nile tilapia introduced into China, the tilapia culture has become a blooming industry. In 1984—2007<sup>1</sup> the tilapia production was increased by 20% annually. It was 18,000 tons in 1984, and reached 1,210,000 tons in 2007. Its proportion in freshwater aquaculture is increasing (Table 1)<sup>2</sup> and ranks 6<sup>th</sup> by species in freshwater aquaculture, just after native species such as silver carp, common carp, bighead carp, grass carp, and crucian carp (Table 2)<sup>3</sup>. At present, the national demand and export demand both is blooming; its culture industry has a very bright future.

### Major kinds of farmed tilapia

Tilapia culture in Mainland China started in 1960s. In 1958, *Oreochromis mossambicus* was introduced from Vietnam. Because of short breeding cycle tend to overpopulate grow-out ponds and the harvesting are smaller in size and lower in market value, this species was failed in China. From 1978, *Oreochromis niloticus* was introduced many times. It has replaced the *O. massambica* by better performance. In 1981, *Oreochromis aureus* was introduced, its major use is to produce the hybrid with high percentage of male with *O. niloticus*. By the way some other species were introduced, such as *Sarotherodon galilaca*, *Tilapia zillii*, etc. But they have not formed the production in China. The major introduction can be summarized in Table 3.

From the 1980s' the major farmed kinds of tilapia include Nile tilapia, the hybrids of Nile tilapia X blue tilapia, as well as red tilapia (Table 4). The blue tilapia is used for making of hybrids but not for the table fish culture. These kinds of tilapia involved many groups /genotypes in the past 50 years (Table 5)

Because of introduction were based on relatively few fish, small founder population, multiple and repeated introduction, poor management in brood stock, deliberate of accidental mixing of stocks, inbreeding within hatchery, much genetic diversity has been lost, loss of genetic variation through genetic drift, inbreeding, hybrid introgression, unconscious selection, such as, early maturation causing of poor growth, low production, low fillet and low profit

Good strains and good management of brooders and seeds is the most critical factor to the development of tilapia industry. But before the introduction, there are no genetically improved strains of Nile tilapia in China.

### **GIFT and its NEW strains**

1992, under the support by ADB and UNDP, the ICLARM and its cooperative institutes from Philippines and Norway, produced a new strain- GIFT Nile tilapia. GIFT strain was introduced into China in 1994 at its 3rd generation. Through 3 years evaluation in three major agro-ecosystems in China from 1994 to 1996, it was found that it has some advantages (such as fast growth) but also some disadvantages (such as not stable in performance). It was certified as a good introduced alien species and named as GIFT strain of Nile tilapia by the National Certification Committee of Aquatic Wild and Bred Varieties (NCCA WV).

Use the GIFT strain tilapia as base population, a new variety was produced over 10 years selection, and certified by the (NCCA WV) as a new variety--NEW GIFT tilapia. The major characters of NEW GIFT strain are as following:

Fast growth (30% faster than that of base population). uniform size( coefficient variation of body weight decreased 30% than that of base population).

Better body shape, small head and deep body.

High fillets ratio (38-40%, 5~8%higher than common tilapia).

Nice stripe pattern on caudal fin.

High genetic purity.

#### **Genetic markers for tracking.**

A. S<sub>304</sub>553bp SCAR - Appear frequency is 86.7% in NEW GIFT, and 16.7% in base population.

B. S<sub>365</sub>368bp SCAR - Appear frequency is 91.4% in NEW GIFT, and 0~70% in other 7 strains.

High efficiency/profits – The NEW GIFT has been extended into over 20 provinces, and becomes a principle major stock in tilapia industry of China.

It is one of the most successful results in fish genetic improvement in China, produces a significant social benefit and economic benefit. By a not completed records in 2005-2007 NEW GIFT tilapia's cultured area reached 87 000 ha increased production 74 800 000 USD in value increased profit 21 900 000 USD in value, and exported 33 400 000 USD in value, totally.

Table 1. The farmed tilapia production and its share in the total national freshwater aquaculture production

| Year | Tilapia production | Total freshwater | Share of tilapia |
|------|--------------------|------------------|------------------|
| 1979 | 8 100              | 813 320          | 1.00             |
| 1980 | 9 000              | 901 475          | 1.00             |
| 1981 | 10 100             | 1 014 060        | 1.00             |
| 1982 | 12 100             | 1 207 176        | 1.00             |
| 1983 | 14 300             | 1 428 198        | 1.00             |
| 1984 | 18 100             | 1 811 136        | 1.00             |
| 1985 | 23 800             | 2 379 188        | 1.00             |
| 1986 | 29 500             | 2 951 500        | 1.00             |
| 1987 | 34 800             | 3 484 082        | 1.00             |
| 1988 | 39 000             | 3 897 474        | 1.00             |
| 1989 | 89 473             | 4 170 255        | 2.15             |
| 1990 | 126 071            | 4 459 114        | 2.38             |
| 1991 | 119 852            | 4 625 875        | 2.59             |
| 1992 | 157 233            | 5 337 931        | 2.95             |
| 1993 | 191 257            | 6 482 589        | 2.95             |
| 1994 | 235 940            | 7 896 596        | 2.99             |
| 1995 | 314 090            | 9 407 600        | 3.34             |
| 1996 | 394 303            | 10 937 000       | 3.61             |
| 1997 | 485 459            | 12 366 600       | 3.93             |
| 1998 | 525 926            | 13 219 100       | 3.98             |
| 1999 | 561 794            | 14 219 740       | 3.95             |
| 2000 | 629 182            | 15 169 365       | 4.15             |
| 2001 | 671 666            | 15 954 960       | 4.21             |
| 2002 | 706 585            | 16 940 493       | 4.17             |
| 2003 | 805 859            | 17 742 734       | 4.54             |
| 2004 | 897 276            | 18 919 972       | 4.74             |
| 2005 | 978 135            | 20 084 654       | 4.92             |
| 2006 | 1 111 461          | 21 483 105       | 5.17             |

Table 2. Top species/group and its production in freshwater aquaculture in China (2006)

| Rank  | Species      | Production tons | Proportion |
|-------|--------------|-----------------|------------|
| Total |              | 21 483 105      |            |
| 1     | Grass carp   | 3 963 382       | 17.19      |
| 2     | Silver carp  | 3 714 740       | 17.29      |
| 3     | Common carp  | 2 590 306       | 12.06      |
| 4     | Bighead carp | 2 372 712       | 11.04      |
| 5     | Crucian carp | 2 094 881       | 9.75       |
| 6     | Tilapias     | 1 111 461       | 5.17       |
| 7     | Bream        | 594 287         | 2.77       |

Resource: Yearbook of Fisheries of China, 2006

Table 3. Major introductions of tilapias in China

| Year                | Introduced strain | Origin                              | Introduced Fish number | Institutions of introduction          |
|---------------------|-------------------|-------------------------------------|------------------------|---------------------------------------|
| <u>Nile tilapia</u> |                   |                                     |                        |                                       |
| 1978                | "78"              | N Nile River ,Sudan                 | 22                     | Yangtze River Fisheries Institute     |
| 1978                | "78"              | Nile River ,Egypt                   | 30                     | Fisheries Bureau of Hubei province    |
| 1988                | "88"              | Lower reach of the Nile river Egypt | 9                      | Fisheries bureau of Hunan province    |
| 1993                | USA               | Auburn University of USA            |                        | National Fisheries Extension Station  |
| 1994                | GIFT              | ICLARM(Philippines)                 | 5 000                  | Shanghai Fisheries University         |
| 1994                | "Egypt"           | ICLARM(Philippines)                 | 3 000                  | Shanghai Fisheries University         |
| 1995                | "95"              | Nile River, Sudan                   | 53                     | Yangtze River fisheries Institute     |
| 1998                | Egypt             | Egypt                               | 3 000                  | Shanghai Fisheries university         |
| <u>Blue tilapia</u> |                   |                                     |                        |                                       |
| 1981                | Africa            | Taiwan                              | 250                    | Fisheries Institute of Guangzhou City |
| 1983                | USA               | American                            | 33                     | Freshwater Fisheries Research center  |
| 1998                | Egypt             | Egypt                               | 3 000                  | Shanghai Fisheries University         |
| <u>Red tilapia</u>  |                   |                                     |                        |                                       |
| 1973                | Israel            | Japan                               | 1 200                  | Zhujiang River Fisheries Institute    |
| 2002                | Israel            | Israel                              | 40 000                 |                                       |

Table 4. Major kinds of farmed tilapia in China

| Kind                  | Characters  |
|-----------------------|---|
| Nile tilapia          | Fast growth, extensive feeding, high fry production               |
| Hybrids (Nile X Blue) | High percentage of male, high mass production! low fry production |
| Red tilapia           | Red color, prefer by some people                                  |

Table 5. Major groups of farmed tilapias in China

| African series<br>(wild)<br>1980-1990's   | Taiwan series (hybrids)<br>1990's  | GIFT series<br>(selected)<br>2000's                         | Red tilapia series<br>(hybrids)            |
|---|--|---|--|
| ▼"78"<br>▼"88"<br>▼"92"<br>▼"98"<br>▼"99" | ▲Wuguo ( <i>O. mosmabicus</i> )<br>▲Fushou <i>O. niloticus</i> X<br><i>O. mosmabicus</i><br>▲Huangqi tilapia<br>▲ Luye tilapia | ● GIFT<br>○GIFT<br>○Geroma GIFT<br>○Baolu GIFT<br>●NEW GIFT | □Esrial red<br>□Taiwan red<br>□Florida red |

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