GENOMAR STRONG

A robust tilapia (*Oreochromis niloticus*) genetically selected for high survival in farming.

Product documentation for:

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GenoMar

Version 1, 2021

Streptococcosis resistance

Streptococcosis infections are one of the costliest diseases affecting tilapia aquaculture worldwide. It causes large mortalities and economic losses, particularly when the water temperature in production systems rises above 30°C.

Development of genetic streptococcosis resistance
Specific resistance against *Streptococcus agalactiae*, the major causative agent of streptococcosis, was implemented as a goal in the GenoMar breeding program in 2016. Since then, for each generation, samples from all families in the GenoMar program are experimentally challenged with *S. agalactiae* to document genetic variance in resistance to the disease. These tests show clear and consistent variability in mortality between the families ranging from 4% to 75% and this variability has formed the basis for selection of families with better survival. In addition, our geneticists can determine the underlying genetic components associated with the differences in mortality, using a technology called genomic selection.

Experimental validation of streptococcosis resistance
An independent laboratory challenge experiment was carried out in 2019 to validate the level of protection achieved after three generations of selection. Streptococcosis resistant selected tilapia was compared with non-selected tilapia using two different routes of challenge administration, intra-peritoneal (IP) injection and cohabitant (cohab) waterborne infection.

The results of the validation experiment clearly showed increased survivability for the selected tilapia in both challenge models. Cumulative mortality due to *S. agalactiae* infection in the selected tilapia was 28.7% and 32.3%, compared to the non-selected tilapia which was 49.7% and 43.0% when using the IP- and cohab challenge models respectively (*Figure 1*).

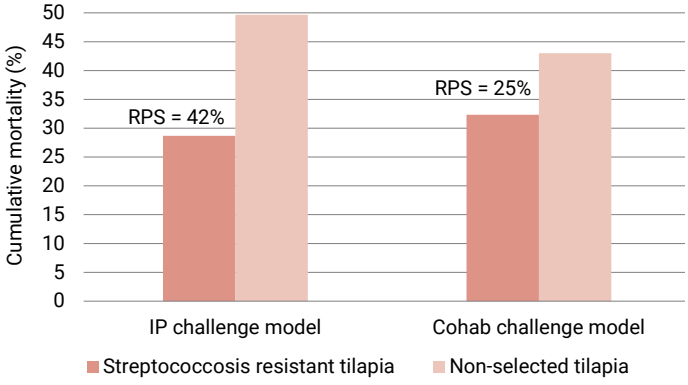

Figure 1. Cumulative mortality in a laboratory challenge test of tilapia fingerlings selected for streptococcosis resistance compared to non-selected tilapia. Two different routes of infections with S. agalectiae were performed. Level of protection is calculated as relative percent survival (RPS).

Field trial in a commercial tilapia farm
Natural infection under industrial field conditions is an important prerequisite to confirm the validity of protection found in laboratory tests. In 2020 tilapia selected for streptococcosis resistance and non-selected tilapia were placed together in cages in a commercial farm to test the different groups under industrial scale conditions.

At 135 days post-transfer to grow out, the cumulative mortality was on average 29.6% for the selected fish and 43.4% for the non-selected fish. The dead fish showed clinical signs of streptococcosis. This result is in line with the laboratory tests and demonstrate that after three generations of selective breeding, survivability is increased throughout the entire grow out phase with approximately 30% (*Figure 2*).

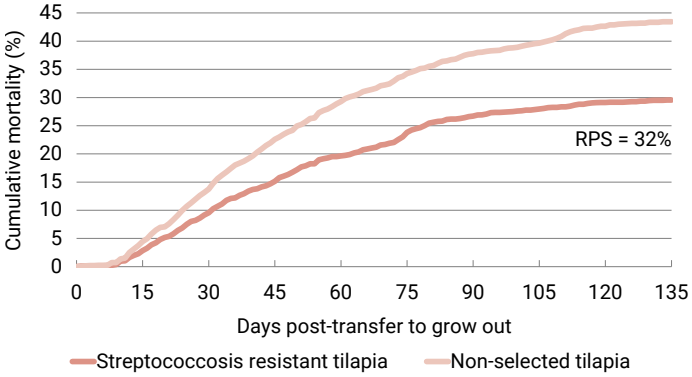

Figure 2. Daily, cumulative mortality in a field trial with tilapia selected for streptococcosis resistance and non-selected tilapia, 135 days post-transfer to grow out. Both groups consisting of around 2000 fish each, were mixed, individually tagged, and raised together in cages at a commercial farm in Malaysia. Level of protection is calculated as relative percent survival (RPS).

Benefits of streptococcosis resistance included in GENOMAR STRONG

- 30% increased survivability against streptococcosis during the entire life of the fish
- Reduce the need of antibiotic treatments
- An alternative or a complement to vaccination
- Less losses at processing due to streptococcosis lesions
- Validation experiments in the laboratory and under field conditions confirms the efficacy of protection against streptococcosis
- Significant improved harvest yield with reduced production cost for each production unit

Growth

Over the last 30 years, genetic selection programes in tilapia have proven to be an important contribution to the development of a cost-effective and sustainable tilapia industry worldwide. Genetic progress on growth have resulted in tilapia breeds that far exceed the performance of their original wild ancestors.

The GenoMar tilapia strain has since the establishment of the founder population originated from Africa and Asia in the late 1980s, been selected for fast growth. Systematically selective breeding for more than 28 generations, using state-of-the-art technologies has led to gradually improvements in growth rate for the strain which is offered to the tilapia farmers today.

Selected for growth in the first generations
During the first 16 generations in the GenoMar breeding program, fast growth was the number one trait and the only selection criteria. The combination of high heritability and strong weighing of traits has generated a solid fundament for the fastest growing tilapia strain in the industry. Other traits like fillet yield, general robustness and specific disease resistance were successively introduced from generation 17 and onward.

Selected for several traits in the recent generations
Development and introduction of new traits in the selection program open for a more balanced selection with more weighing on traits targeting robustness/survivability and productivity. This development has taken place since 2006 and enables for a more differentiated product portfolio, with traits adapted to different farming conditions.

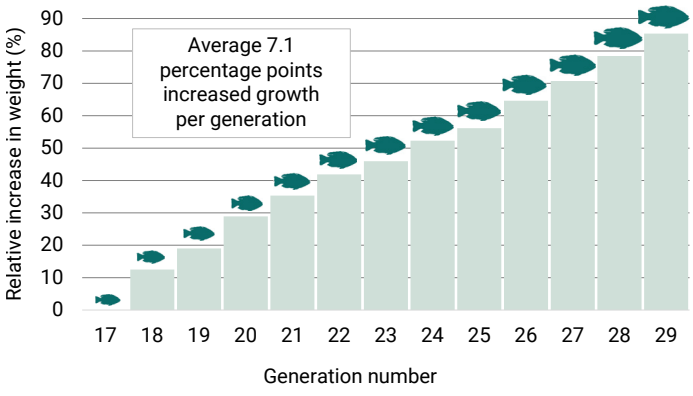

Figure 3. Relative increase (percentage points) in body weight for the recent twelve generations of GenoMar tilapia breeding populations. The 17th generation is used as the base line for calculating the increased body weight per generation succeeding. Growth has been weighted around 40-50% and other traits are weighted for the remaining 100% when selecting for the next generations.

In these recent generations the growth has been weighted around 40-50%, but still generate a significant genetic progress estimated to an average improved growth performance of 7.1 percentage points each generation (*Figure 3*).

The increased growth, fillet yield, robustness and specific disease resistance achieved from these selections are steadily improved when producing new generations. This means that the selection done through the years will be added to the continued progress. A comprehensive recording program ensures that the risk of unwanted or unexpected side effects is minimized.

Selection for GENOMAR STRONG
When producing fingerlings and juveniles to the farmer, the weighing of traits in the final selection of parent stock is based on the predetermined desired genetic profile. The best performing parents matching the profile is then picked for mating.

In GENOMAR STRONG we have kept the solid underlying growth and fillet yield performance and continued the robustness and specific disease resistance improvements developed through many generations of systematic selections.

Benefits of growth included in GENOMAR STRONG

- Increased growth rate accumulated from selection of more than 28 generations
- Reduction in the number of farming days
- Less exposure time to disease and environmental risks
- Improvement in the annual yields per hectare or per production unit as more cycles can be made
- Cost reduction arising from more yields per hectare and per worker, lower mortality, and better feed conversion rate (FCR)

Product specifications

GenoMar delivers genetically improved fingerlings and juveniles of GENOMAR STRONG to farmers for stocking directly into ponds or cages.

To achieve the best possible growth rate, the fish is produced as all male with at least 98% males.

Available sizes delivered from our hatcheries

Fingerlings:	0.25-2 grams
Juveniles:	20-40 grams (from Vietnam only)

Time of delivery

Fingerlings are supplied year-round.