SALMON EGGS 2020/2021

Start material with the best potential for growth, survival and fillet quality
AquaGen carries out several selections of broodstock at different stages before the final selected are allowed to produce eggs for the farmers. The selection process occurs both at the family- and individual level.

The AquaGen stock is based on collection of Atlantic salmon from 40 Norwegian rivers and thereafter bred since the early 1970s. How long the different traits have been selected for, as well as the intensity of the selection is very important for the total progress which today’s products represent.

At the present time a total of more than 20 traits are recorded from 1000 families. A comprehensive recording program ensures progress in these desirable traits while at the same time minimizing the risk of unwanted or unexpected side effects.

Since 2009 AquaGen has implemented new modern technology called Marker Assisted Selection (QTL-selection). Based on this new technology platform we are able to directly select parents to be used in egg production that possess a specific genetic marker (QTL) that are highly associated with resistance to specific viral diseases and fillet colour. In addition we have found a QTL for lice resistance. By removing broodstock with the unwanted QTL from breeding and egg production, we get a lower proportion of particularly susceptible fish in the cages.

AquaGen has developed the world’s most powerful “search tool” to find broodstock genes that make them suitable to meet the biological challenges the salmon industry faces. This so-called SNP chip can analyze up to 930,000 genetic markers per fish which are then correlated with desirable and undesirable traits. Later on, we have improved and optimized the tool several times. The size and quality of the SNP chip are crucial for what can be achieved by adopting QTLs and genomic selection, which is now at full speed into the most professional breeding programs related to agriculture and aquaculture.

From 2016 AquaGen has been delivering eggs which are selected by genomic selection. This means that several thousand genetic markers are used for selecting broodstock with a specific trait. Compared with family selection, genomic selection is more precise and it gives greater progress since selection takes place at the individual level. Resistance against lice and additional progress on growth are selected by this method.

More documentation on the products can be found here: http://aquagen.no/en/products/salmon-eggs/product-documentation/

Figure 1. The main traits measured, selected and controlled in the breeding program (nucleus) of Atlantic salmon (Salmo salar L.) are set up in relation to the year of implementation and which selection methods that are used for the different traits.
Biosecurity and quality control

Fish health surveillance in AquaGen is carried out through the entire life-cycle of the fish. In the final nine months before stripping the monitoring is intensified. This includes comprehensive autopsy and screening of all broodstock populations in the AquaGen system.

Production is monitored by both internal and external fish-health personnel, and by government and private entities. AquaGen is certified according to GLOBAL GAP (food safety, environmental protection, fish welfare, and health, safety and welfare for employees), ISO 9001 (quality leadership), RSPCA (animal welfare), Code-EFABAR (good practice within animal farm breeding and reproduction) and EU Organic (organic aquaculture).

AquaGen’s broodstock populations are routinely screened for PD virus, ISA virus and BKD bacteria throughout the production phase. Individual testing of parents for desired agents can also be done on demand.

Relevant health information of broodstock, eggs and fry is documented in a separate HEALTH resume and enclosed all deliveries.

Delivery time

AquaGen deliver salmon eggs throughout the year from Norwegian production facilities. In addition, our plant in Scotland is capable of delivering in the period October to May. In Norway, both land based and sea based broodstock are used to offer eggs in all months of the year. In Scotland, sea based broodstock are currently used only.

Figure 3. Time of salmon eggs delivery throughout the year based on brood stock farmed both in sea and on land.

Ordering time limit

From the 2016/2017 egg season the product range in AquaGen was expanded with new products, adapted to the current challenges the industry is facing. This places great demands on planning and logistics associated with testing and selection of broodstock and the production and distribution of eggs.

We produce eggs by order and it takes a minimum of seven weeks from the eggs are fertilized until they are ready for dispatch. To meet egg orders in terms of quality, quantity and delivery time, we urge therefore our customers to make reservations as early as possible. Ordering deadline for desired delivery of eggs in Q1, Q2 and Q4 is 10 weeks before and in Q3 and for special products (products with many additional selections) is 26 weeks before.

Depending on the results of genotyping of the season’s broodstock, certain types of products may have limited availability.

Should there be a requirement for unexpected additional eggs, due to operating accidents, diseases or lack of capacity in customers own facilities, AquaGen often has the ability to help out with deliveries in such situations.

Figure 2. AquaGen is certified according to the standards GLOBAL GAP, ISO 9001, RSPCA, Code-EFABAR and EU Organic.
All broodstock undergo initially a traditional family selection based on information from over 20 measured traits. After the best broodstock candidates have been selected on this level, in which the growth feature is extra weighted, samples are taken for DNA analysis and search for genetic markers (QTLs) associated with different traits is performed. Below is an overview of the product types and qualities they are selected for with the use of QTL- and genomic selection. QTL-inOva® HSMI, RED, LATEMAT and FLAVO are additional choices for specific products. After the main product is chosen, we also offer different treatment types of broodstock/eggs. More documentation on the products can be found here: http://aquagen.no/en/products/salmon-eggs/product-documentation/

<table>
<thead>
<tr>
<th>Product name</th>
<th>Traits</th>
<th>QTL-selection</th>
<th>Genomic selection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>IPN LICE PD CMS HSMI RED LATEMAT FLAVO</td>
<td>3G LICE 1G AGD 3G GROWTH</td>
</tr>
<tr>
<td>AquaGen® Atlantic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QTL-inOva® PRIME</td>
<td>•</td>
<td>★</td>
<td></td>
</tr>
<tr>
<td>QTL-inOva® SHIELD</td>
<td>•</td>
<td>★ ★ ★</td>
<td>★</td>
</tr>
<tr>
<td>GEN-inOva® GAIN</td>
<td>•</td>
<td>★ ★ ★</td>
<td>★ ★ ★ ★</td>
</tr>
<tr>
<td>TERRA-nova®</td>
<td>•</td>
<td>★ ★</td>
<td></td>
</tr>
<tr>
<td>+ QTL-inOva® HSMI</td>
<td></td>
<td>★</td>
<td></td>
</tr>
<tr>
<td>+ QTL-inOva® RED</td>
<td></td>
<td>★</td>
<td></td>
</tr>
<tr>
<td>+ QTL-inOva® LATEMAT</td>
<td></td>
<td>★</td>
<td></td>
</tr>
<tr>
<td>+ QTL-inOva® FLAVO</td>
<td></td>
<td>★</td>
<td></td>
</tr>
</tbody>
</table>

* = male fish with the worst gene variants for early maturation is not used as broodstock

**Additional treatment of broodstock and eggs**

After the egg type is selected, one or more treatments of the broodstock/eggs can be chosen:

**AquaGen® Atlantic TRACK**
DNA tracking of farmed fish where potential escapees can be checked against the parent fish (both female and male) which are used for a specific egg delivery. DNA analysis will confirm or deny the relationship between parents and offspring and track the fish back to the owner.

**AquaGen® Atlantic STERILE**
Sterilization of eggs which after pressure treatment on recently fertilized eggs makes the fish sterile. This procedure can normally be done on all types of eggs listed above.

**AquaGen® Atlantic ORGANIC**
Organic eggs from broodstock which are farmed so that any infectious agents, parasites and drug residues should not affect wild organisms. Impregnation of nets with copper is not allowed and in control of lice, cleaner fish are used. The density of fish should not cause behaviors such as stress or fin biting/damages and the fish should have the opportunity to school. The raw materials for feed are from organic farming or trimmings from sustainable fishing.

**AquaGen® Atlantic ALL FEMALE**
Milt from verified transformed female brood fish instead of normal male brood fish are used. The offspring will be female fish only.

**VIRUS AND BACTERIAL TESTING**
Individual testing of female- and male brood fish at the time of stripping can be performed. Brood fish free from virus and bacteria are then used in the egg production only.

**FRY**
Depending on the capacity, alevins (about 0.2 grams) and first fed fry (1-5 grams) can be delivered of all egg types mentioned above.