Aquaculture Biotechnology

Genetic manipulations in fish

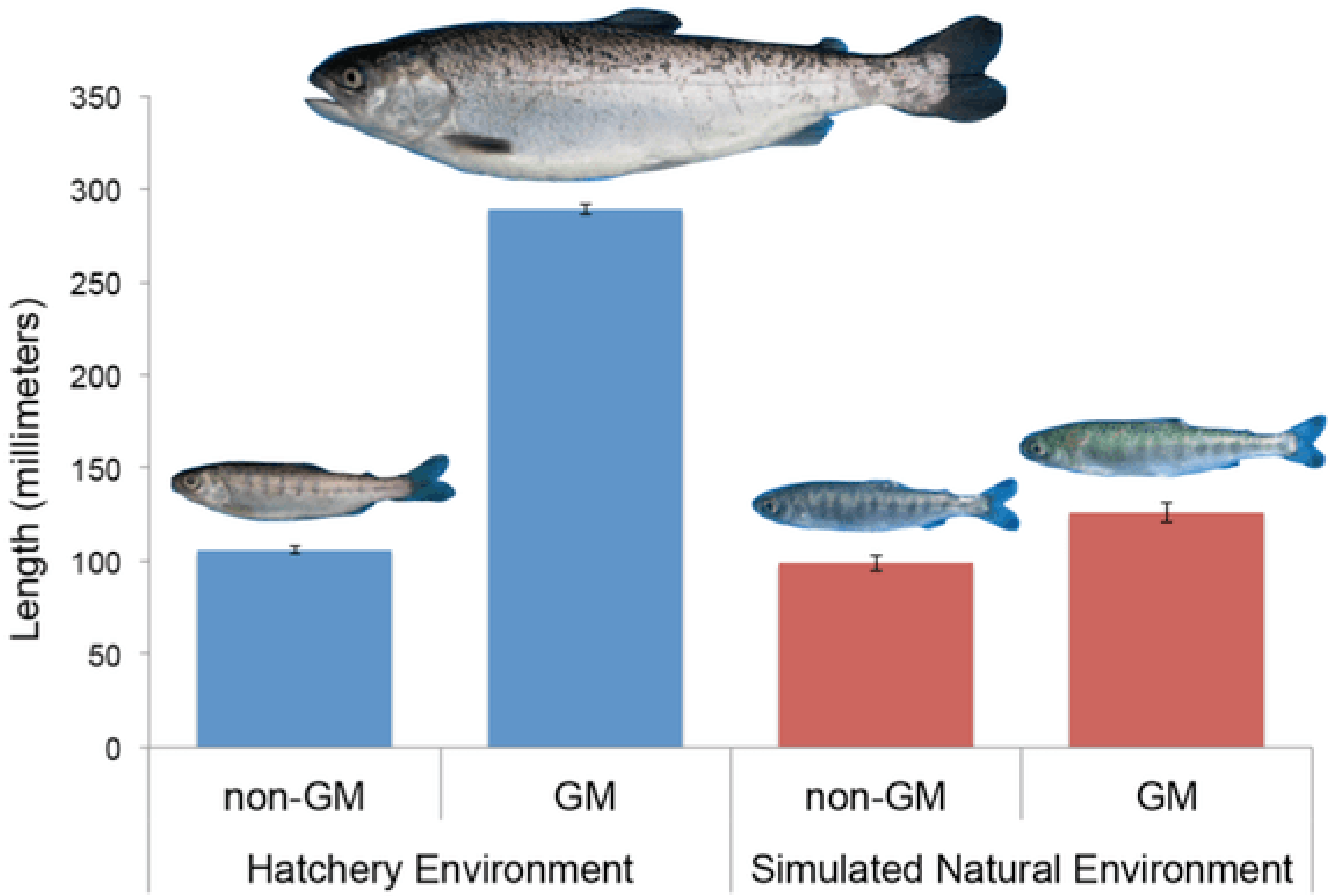
Genetic technologies in Aquaculture

- The application of genetic principles to aquatic species used in aquaculture is a relatively recent phenomenon
- the sector has not yet made full use of available technologies to increase production as other food producing sectors have done.
- only over the past two decades that genetic improvement and the application of biotechnologies has an important role to play in aquaculture development

Genetic technologies in Aquaculture

- significant genetic gains through appropriate application of well planned genetic breeding programmes for aquatic species.
- Improvements in marketability, disease resistance, body shape, color, culturability, and the conservation of natural resources can be facilitated by the appropriate genetic technology.
- Genetic improvement programmes can be used to provide short-term or long-term gains.

GMOs can influence genetic diversity in Aquaculture



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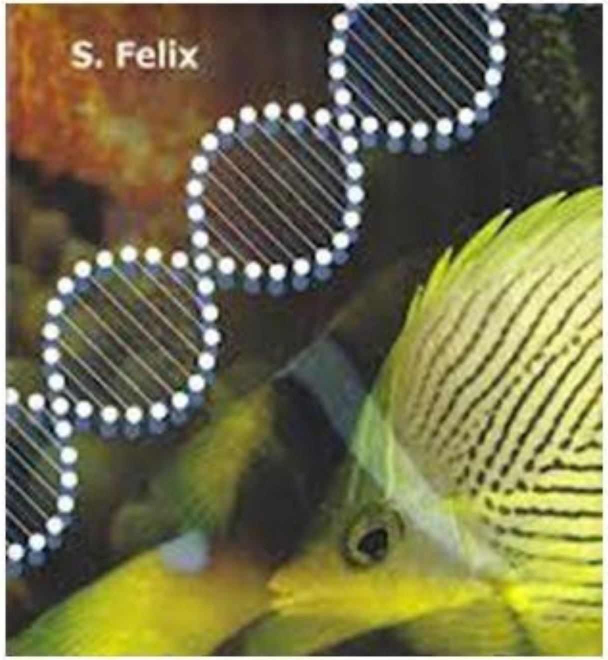
Genetic technologies in Aquaculture

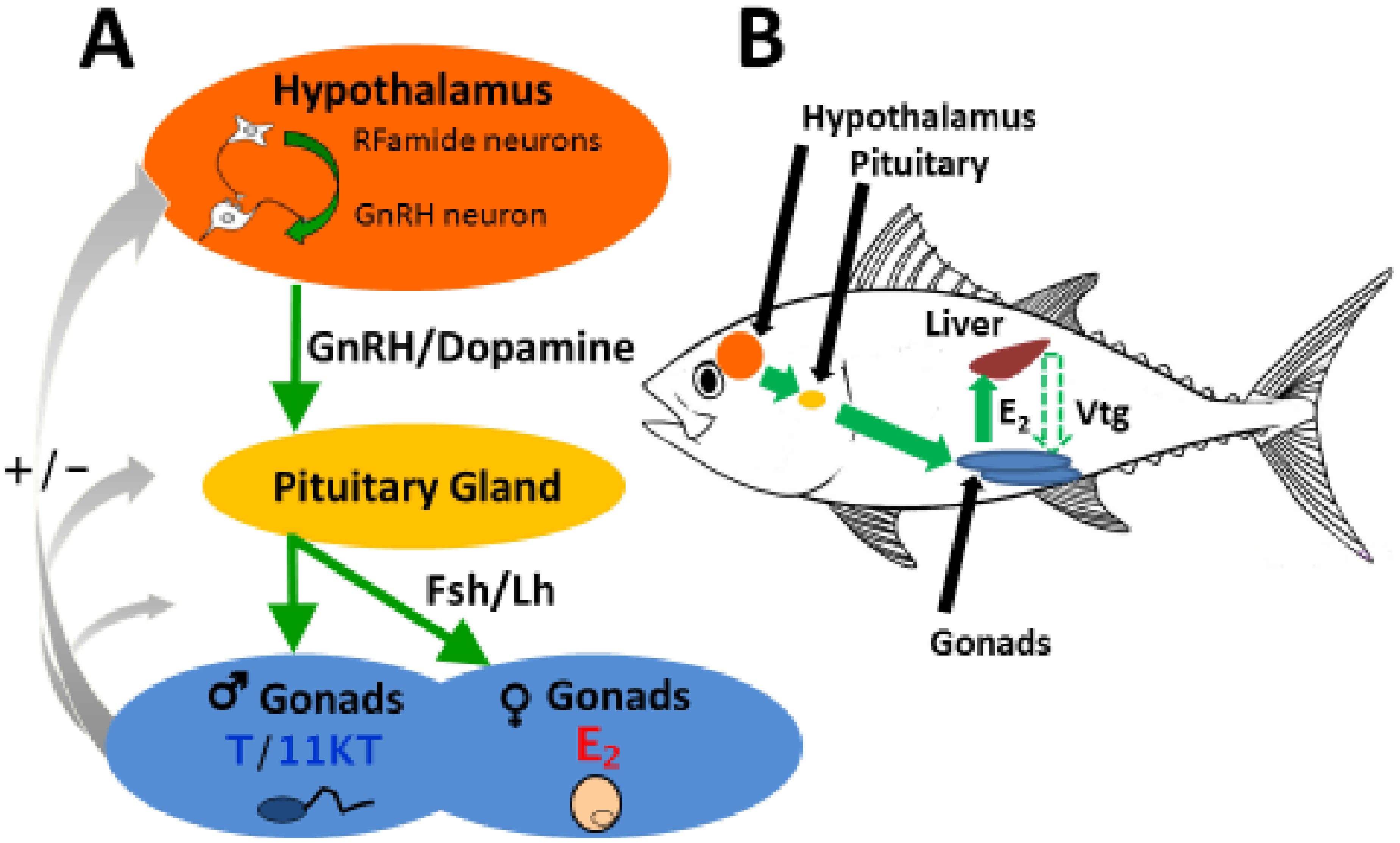
- The short term gains are usually immediate, within two generations, and generally not cumulative
- whereas the long term programmes such as selective breeding produce gains that accumulate each generation.

Applications of biotechnology in aquaculture

- control of reproduction
- growth enhancement
- genetic characterization
- control of diseases
- metabolic engineering
- transgenesis



Role of Aquaculture Biotechnology in Fish reproduction



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Long-term genetic improvement strategies

- Domestication and the full potential for the utilization of aquatic genetic resources will only be realized through long-term breeding programmes.

- The aquaculture sector lags far behind the crop and livestock sectors with regard to the development of domesticated and genetically improved strains.

Long-term genetic improvement strategies

- Selective breeding
- Growth rate is the characteristic most often improved in selective breeding programmes
- increases of up to 20% per generation.
- Other traits have been shown to have additive genetic variance and therefore, amenable to improvement.

Long-term genetic improvement strategies

- Traits such as disease and stress resistance, timing of maturity and flesh quality are now being increasingly included in selective breeding programmes.

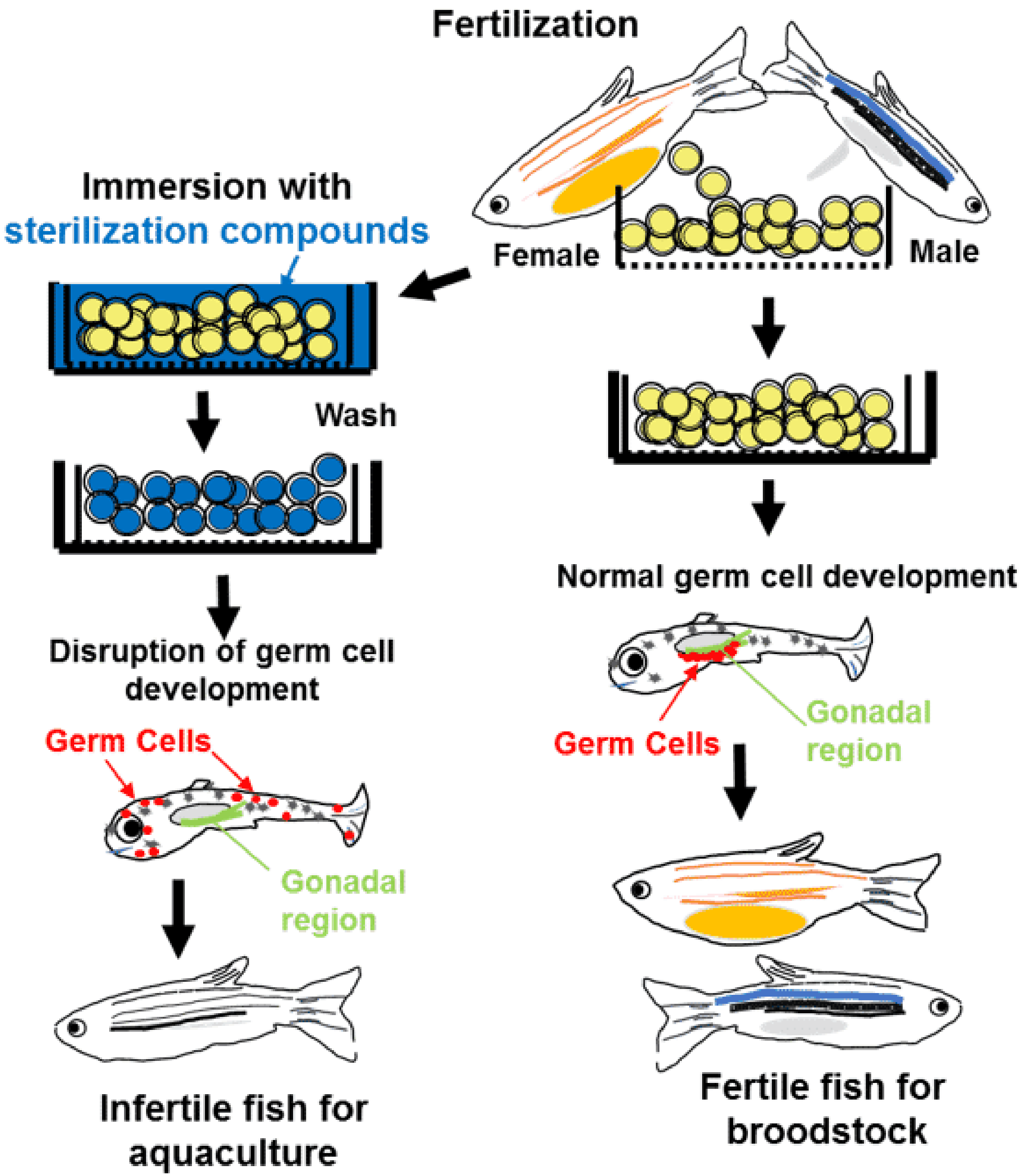
Long-term genetic improvement strategies

- Breeding programmes have been expanded and their design optimized, and new ones initiated.
- Examples of species used in recent breeding programmes include **Atlantic cod, Atlantic salmon, common carp, gilthead seabream, hybrid striped bass, Lake Malawi tilapia, Mediterranean sea bass, Nile tilapia, red sea bream and rohu carp**

Long-term genetic improvement strategies

Selective breeding

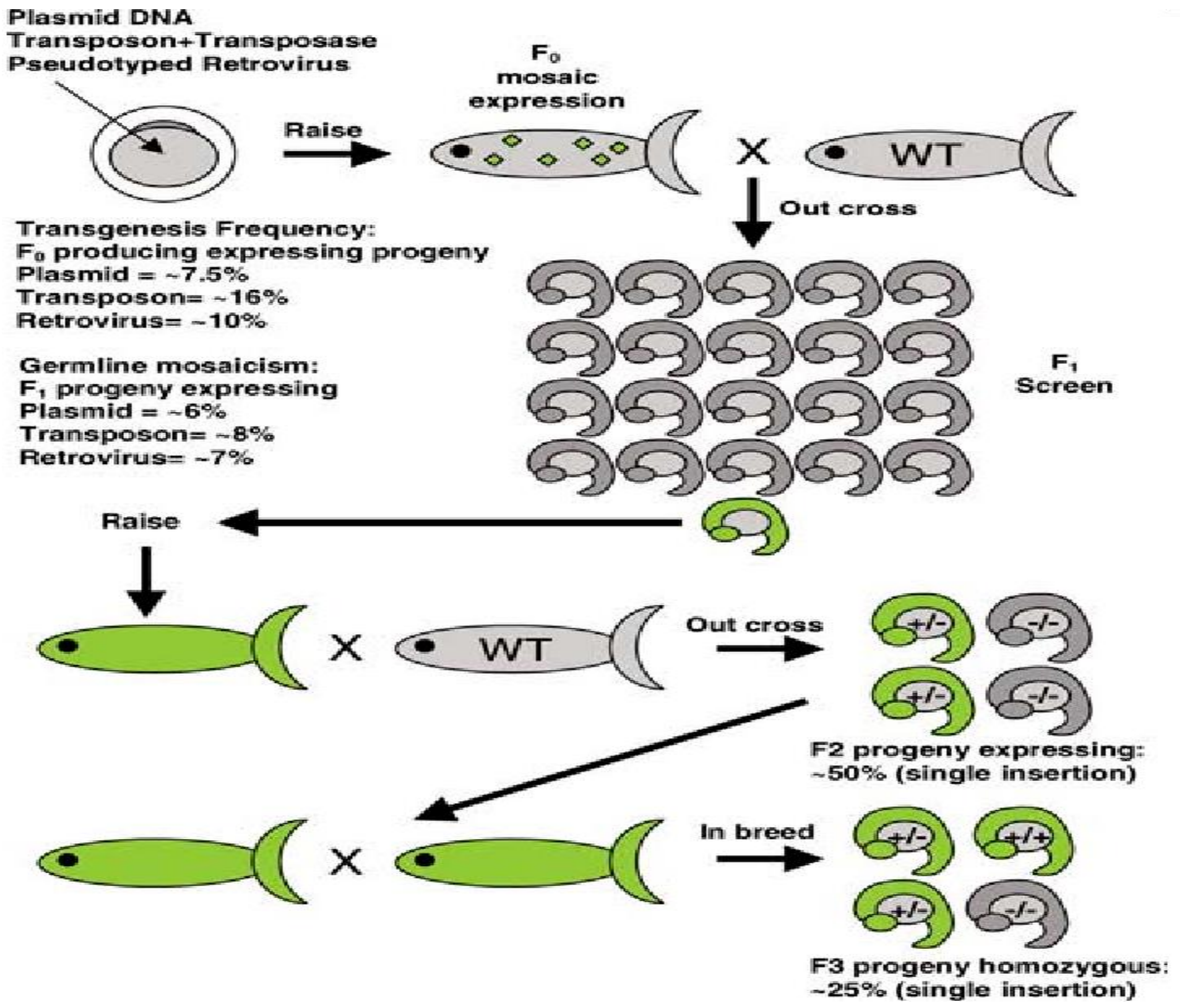
- On disease resistance, the adoption of domesticated and genetically improved whiteleg shrimp Penaeus vannamei resulted in a drastic increase in shrimp aquaculture output
- but also posed serious risks of persistent infections, e.g. with viral pathogens that can be passed from broodstock to postlarvae.
- The use of specific pathogen free (SPF) domesticated shrimp should be supported by robust biosecurity as a prime consideration


Fertilization
Female
Male
Immersion with
sterilization compounds
Wash
Disruption of germ cell
development
Germ Cells
Gonadal
region
Infertile fish for
aquaculture
Normal germ cell development
Germ Cells
Gonadal
region
Fertile fish for
broodstock

Long-term genetic improvement strategies

Selective breeding

- Another potential application of genetic selection techniques is in the area of enhancing feed utilization, i.e. to determine whether carnivorous fish with natural capacity for protein utilization as main energy source can be genetically selected
- Classic selective breeding programmes will continue to be the main engine driving the global finfish aquaculture industry forward



Generation of transgenic fish expressing GFP

https://www.researchgate.net/profile/Karl_Clark/publication/7874658/figure/fig1/AS:394572921360385@1471084923345/Generation-of-transgenic-fish-expressing-GFP-The-GFP-transgene-is-introduced-into-the.png