

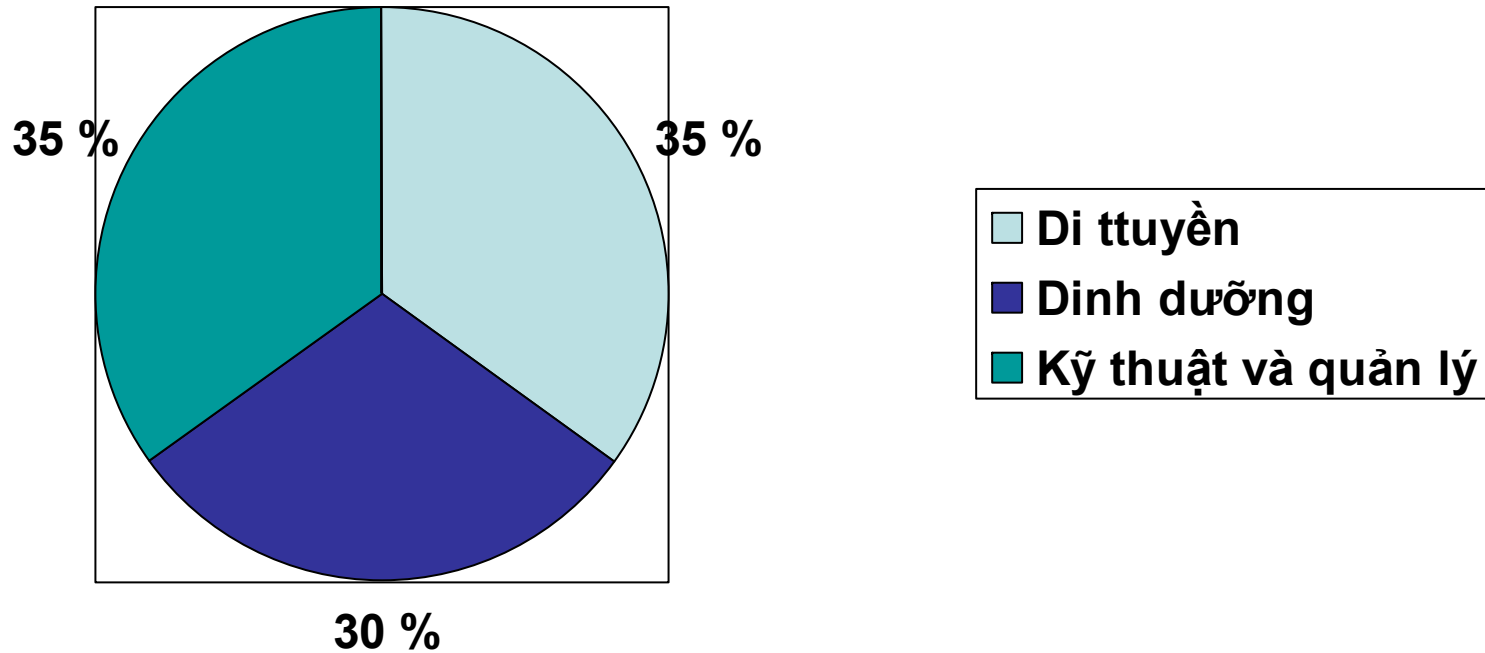
Methods for enhancing quality of fisheries seeds through genetic improvement

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Decisive factors for seed quality



Key methods

1. Hybridizing
2. Inbreeding
3. Hybridizing that avoids inbreeding, seed selection
4. Genetic technologies
5. Advanced bio-technologies – gene technologies
6. General application for seed quality improvement.

1. Hybridizing

- Taking the advantages, i.e. the outstanding characteristics of 2 strains or species when hybridizing.
- Easy to implement, low cost, can be applied at hatcheries.

1.1. Inter-species hybridizing:

- Between 2 species of different families
 - It is very difficult to happen
 - Unfertile hybrid animal
 - However, it can be happened as in case of Flower Horn (*Rajah cichlasoma*) in the 90s.
- Between different species of the same race:
 - Guppy fish: different colors
 - Discus fish: different colors
 - Yellow catfish x Clarias catfish: good taste flesh x rapid growth: *Clarias macrocephalus* x *C. gariepinus*
 - Wels catfish x green wels catfish: *Ictalurus punctatus* x *I. furcatus*
 - Tilapia: *Oreochromis niloticus* x *O. aureus*: high rate of male Tilapia
 - *O. mossambicus* x *O. niloticus*: rapid growth of 25%, salinity tolerance

- Hybridizing between different strains of the same specie: hybridizing of populations that live geographically far from each others
 - Common carp: based on different hybridings among various strains, 3 hybridizing techniques have been worked out that give 20 – 25% of advantages as compared to the traditional strains, i.e. Szarvas 215, Szarvas P.31 and Szarvas P.34. During the 80s, 80% of common carp production in Hungary was based on the hybridizing advantages of HAKI
 - American catfish: 2 strains of Marion x Kansas: 25% improvement for disease resistance and 55% improvement for growth rate.
 - The average level of hybridizing advantage for internal and cross-breeding among 8 strains of Tilapia (*Oreochromis niloticus*) is 4.3%, of which there were 2 techniques with hybridizing advantage of 11 and 13%;

- For rainbow trout, the level of hybridizing advantage is 25%.
- 3 techniques that allowed exceptional growth rate up to 35% in case of hybridizing between Thai strain and 3 other strains.
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- Tien Giang silver carp x Can Tho silver carp
- Taking the hybridizing advantages in order to improve the growth rate.
- Koi Fish

2. Inbreeding

- Means close copulation among individuals of the same genetic type, i.e.: children hybrid with parents, children individuals of the same population.
 - Increase homozygous rate, create form homogeneity: applied for ornamental fishes.
 - High risk of degradation, deformity and mortality rate.
 - Inbreeding rate:
 - $\Delta F = 1/2N$
 - $N_e = 4NmNf/Nm+Nf$
 - 1 male x 2 females: 25 males x 50 females, $N_e=67$, $F=0.75\%$ (0.67%)
 - 1 male x 1 female: 25 males x 25 females, $N_e=50$, $F=1\%$

Avoid inbreeding:

- Stocking population: 250 – 300 individuals
- Represented for 30 – 40 parents of the previous generation
- $N_e=100$
- $\Delta F=0,5\%$

3. Seed selection and inbreeding avoidance

- Mono-gene character:
 - 1-4 decisive genes;
 - Quality character: color, types of color, types of scale.
 - Types of scales for common carp
 - Colors of Koi carp
- Multi-gene character:
 - Many decisive genes: 100 genes
 - Quantity character: growth, fillet, FCR, disease resistance, fat, color of flesh

- Selection:
 - Changing populations in the good ways,
 - Selection of the individuals with a good genetic characteristic for the next generation,
 - Depending on the genetic ratio
 - Children – children genetic value = (Father genetic value + mother genetic value)/2 +/- Mendelian sampling
- Material formation:
 - Rich gene source: 4-5 populations
 - Inbreeding avoidance: optimal contribution selection
- Selection characters :
 - Growth, FCR, disease resistance, color of flesh, fat in fillets, early maturation, etc.

- Marking method:
 - Number writing
 - Cold, hot carving
 - Floy tag
 - Electrical marking
 - Color ing
- Selection method:
 - Individua selection
 - Family selection
 - Integrated selection
- Distribution:
 - Improved seeds are distributed to hatcheries for mass production

International seed selection programs and their effectiveness

- Salmon
 - Faster growth: 100%
 - FCR: decreased from 1.1 to 0.85
- GIFT Tilapia
 - Faster growth: 60%
- Wels catfish:
 - Rapid growth:
- Tiger shrimp and Vannamei:
 - Resistance with TSV: 18%

Seed selection programs in Vietnam and their effectiveness

- Common carp
- GIFT Tilapia
- Silver carp
- Catfish (Tra)
- Red Tilapia
- *Macrobrachium rosenbergii*

4. Genetic technologies

- Monosex production:
 - Gynogenese
 - Sperm deactivation: UV
 - Shock: temperature (high, low), high pressure
 - Examples: Koi carp, silver carp
 - Androgenese
 - Egg deactivation
 - Control of hormone and sex gland:
 - Male monosex:
 - 17^α methyltestosterone
 - » Tilapia
 - » Production of female monosex climbing perch
 - Male gland cutting: TCX
 - Female monosex: Estrogen
 - Production of male monosex Tilapia YY
 - » B-estradiol: female monosex with chromosome XY
 - » Female XY x normal male XY
 - » 25% YY male; analysed hybriding
 - » YY male: B-estradiol; x YY normal male

- Polyploid

- Triploid

- Fertilization
 - Cold shock/short pressure shock after fertilization (post period II)

- Tetraploid

- Fertilization
 - Cold shock at the middle of the 1st cell separation period

5. Advanced biotechnology – gene technology

- Evaluation of the population variability for selection purpose: microsatellite indicator, AFLP, RAPD
- Linking indicator with the selected character (QTL & MAS):
 - Difficult to implement the character, due to selection and high economic value
 - Disease resistance, FCR, breeding capacity, cold and salinity tolerance
 - Costly and time consuming
- Gene transplantation:
 - The difficulty is whether the transplanted gene will be passed to the next generation.

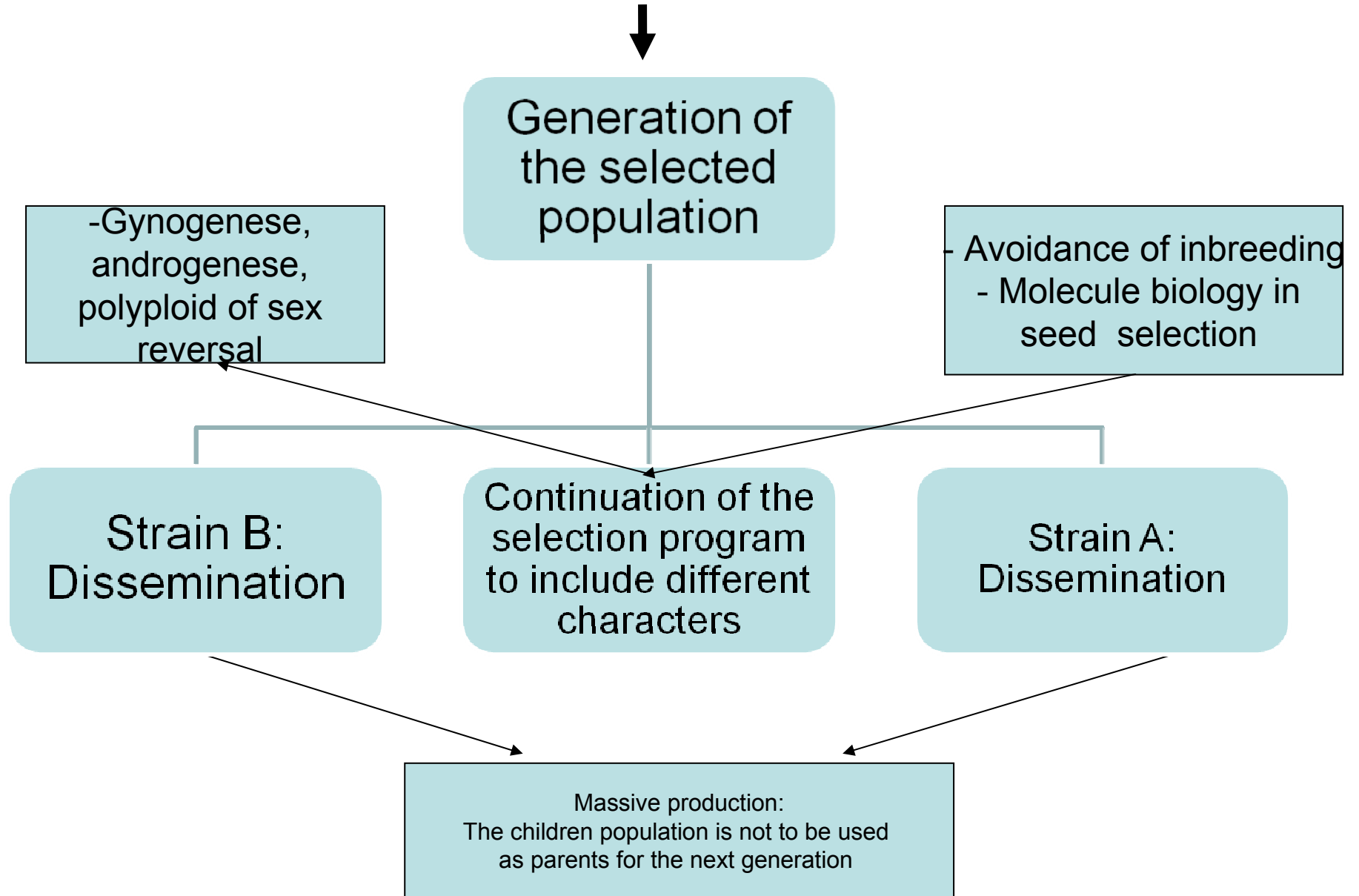
6. Synthesized application for seed quality improvement

Population generation from various sources



Cross hybrid: to obtain advantages





Broodstock control and production

1	Quantity of kept broodstock	
2	Broodstock maturation age	
3	Broodstock size for breeding	
4	Number of breeding per year	
5	Male/Female ratio	
6	Number of couples/breeding	
7	Fish maturation level	
8	Number of rejected years	