

# Overview of poultry industry and selection criteria adopted

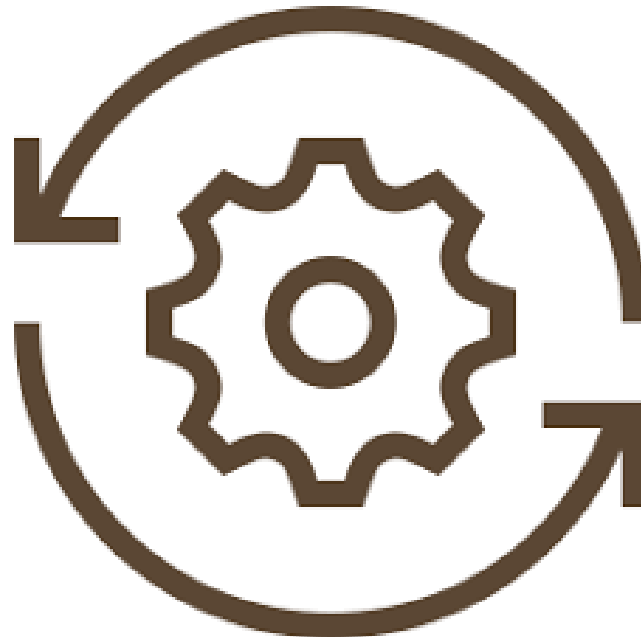


## SYSAAF : French poultry and aquaculture breeding association

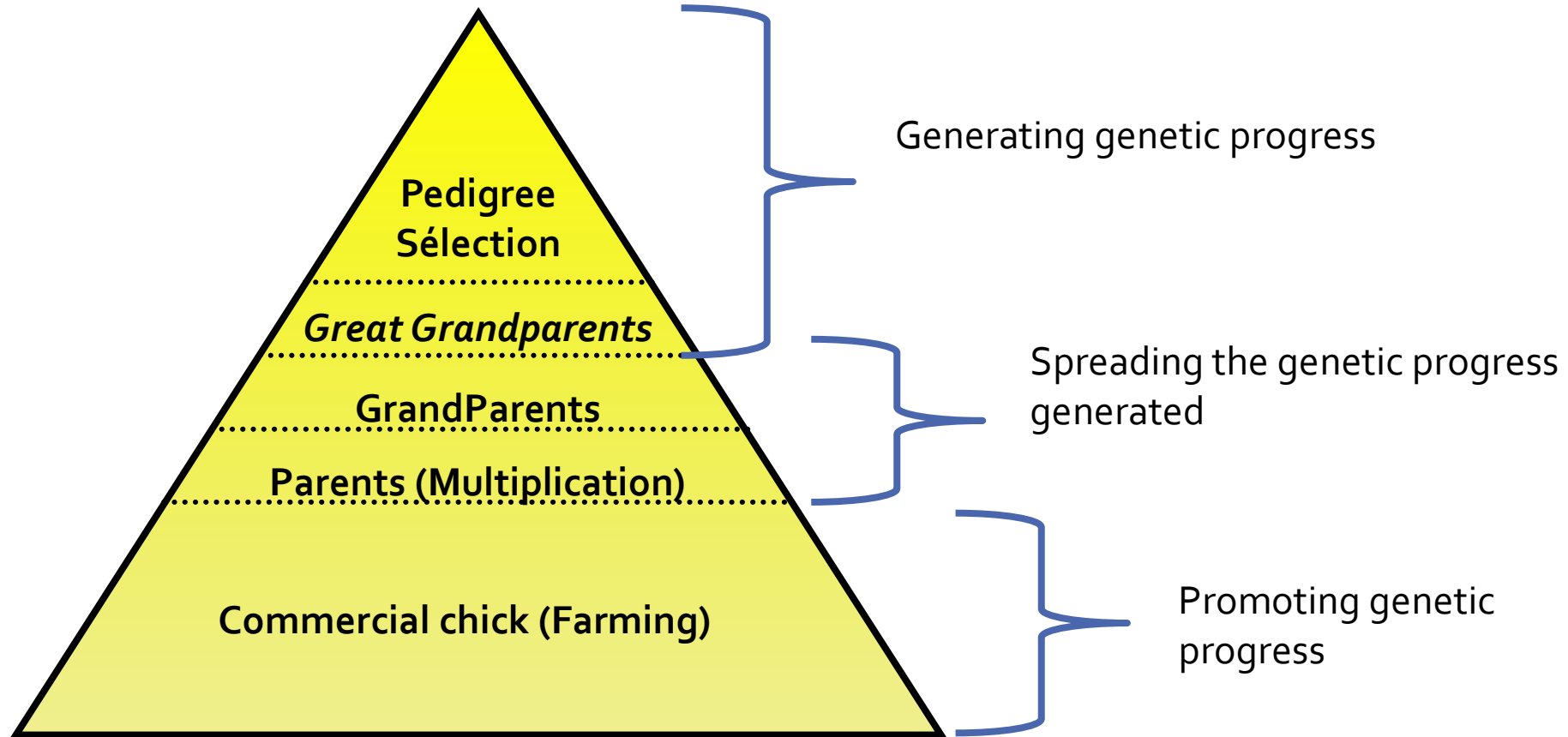
- **Trade association** (Law 1884)
- Technical support for members (37 in 2022) in the fields of **reproductive biotechnology and the management and/or genetic improvement** for poultry, aquaculture and entomoculture species
- Carrying out "**Label Rouge**" audits
- **Preserve** the quality and diversity of national gastronomy by producing: oysters, trout, salmon, sturgeon caviar, duck or goose foie gras, duck or goose breast, chicken, capon, farmhouse turkey, roast duck, roast goose, guinea fowl, game (pheasant, partridge), etc.

# French avian industry organisation

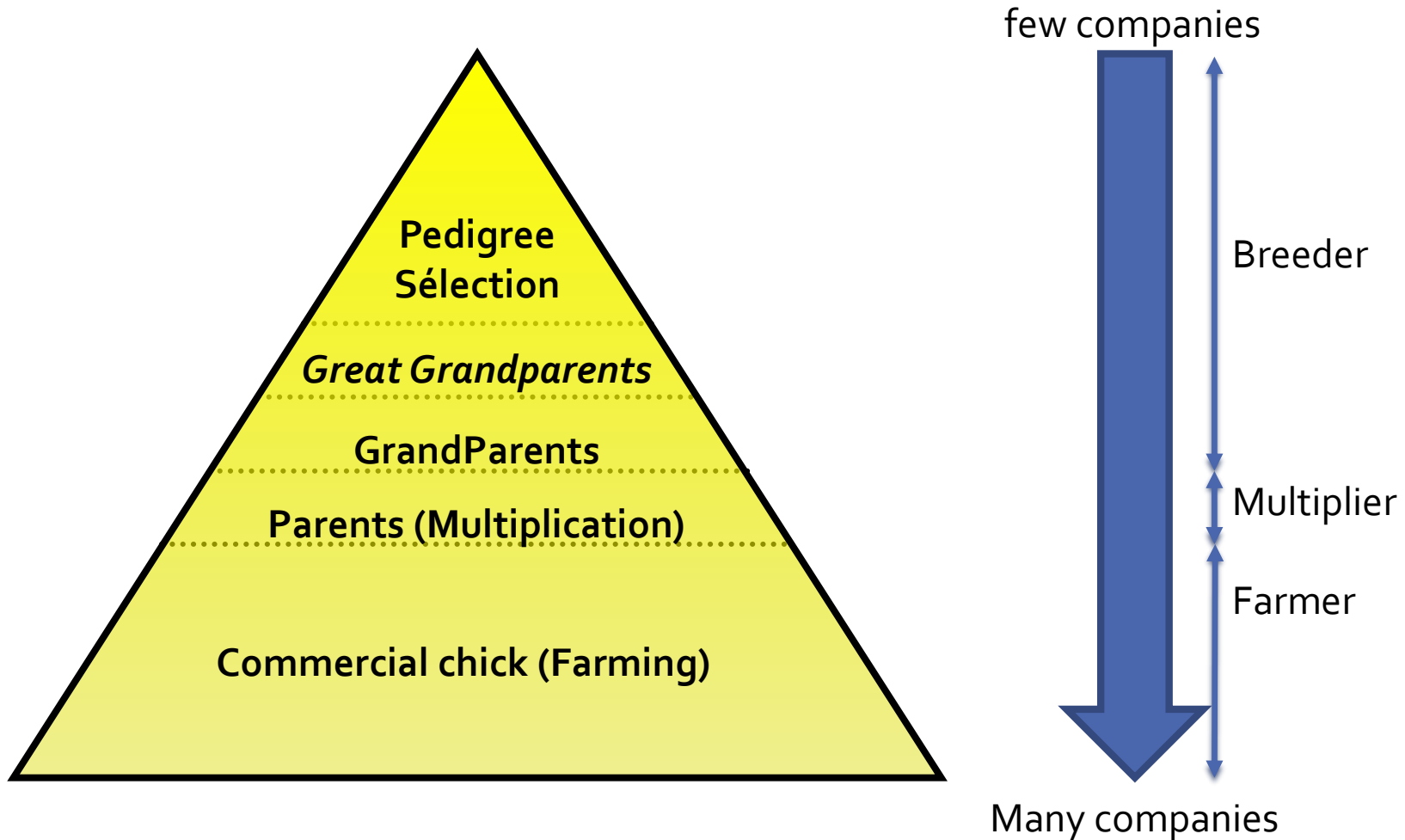
Which actors?



## Pyramidal organisation

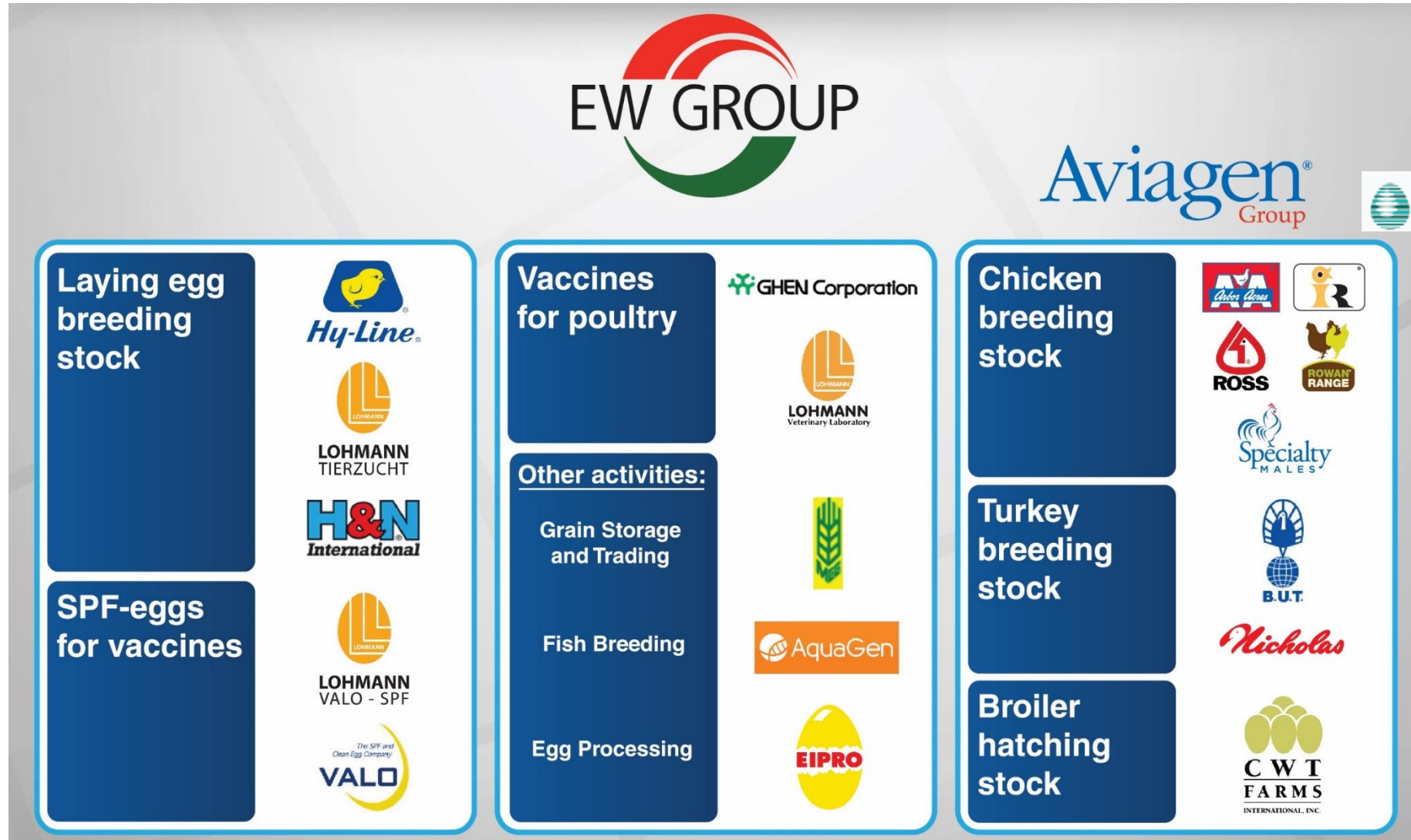


## Pyramidal organisation



# Overview of poultry breeding companies

- International leaders:



 **Hubbard**

+ Hubbard  
(01/01/2018)

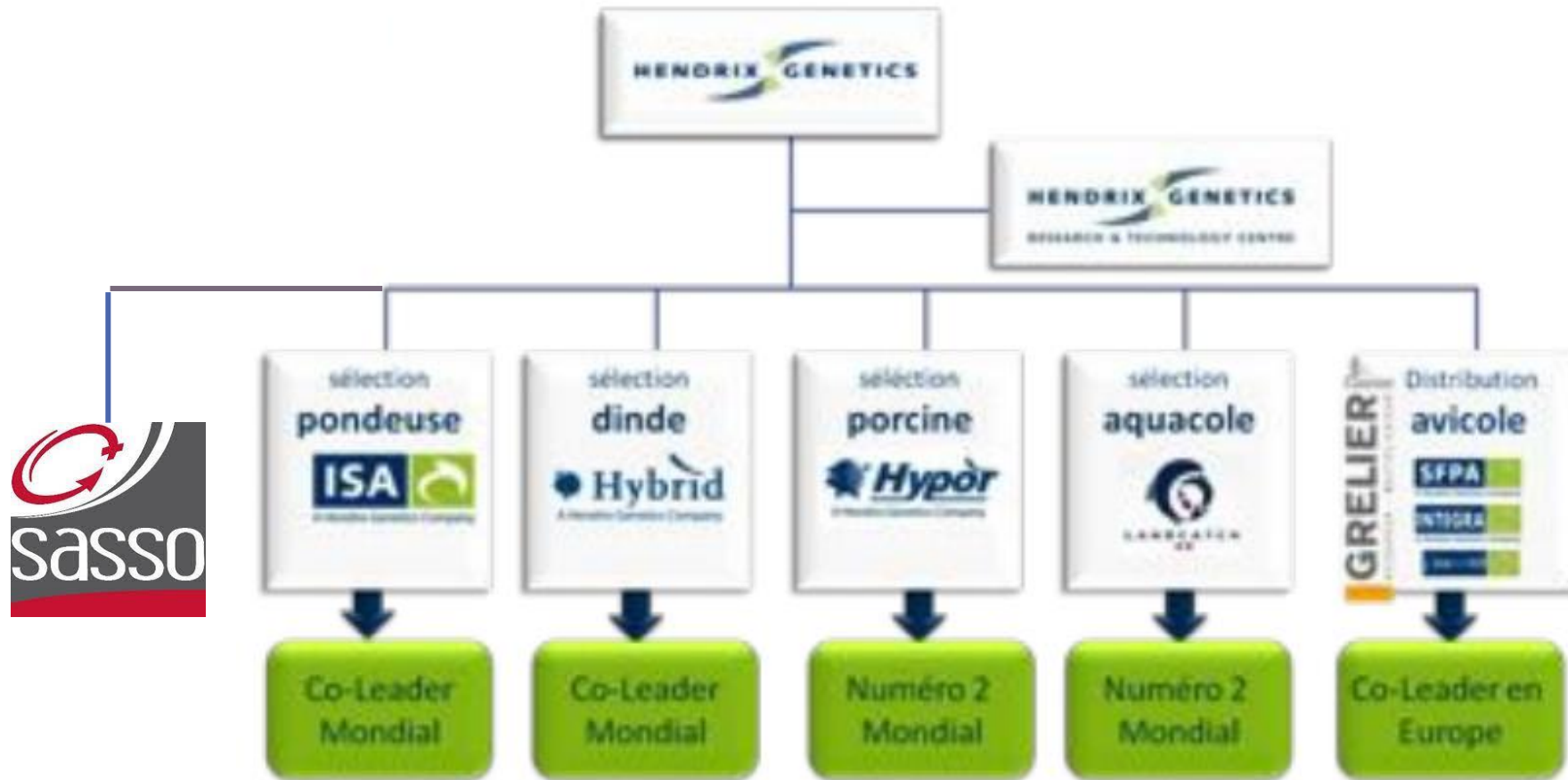
  
**novogen**  
Genes for better eggs

2022

  
**SYSAAF**

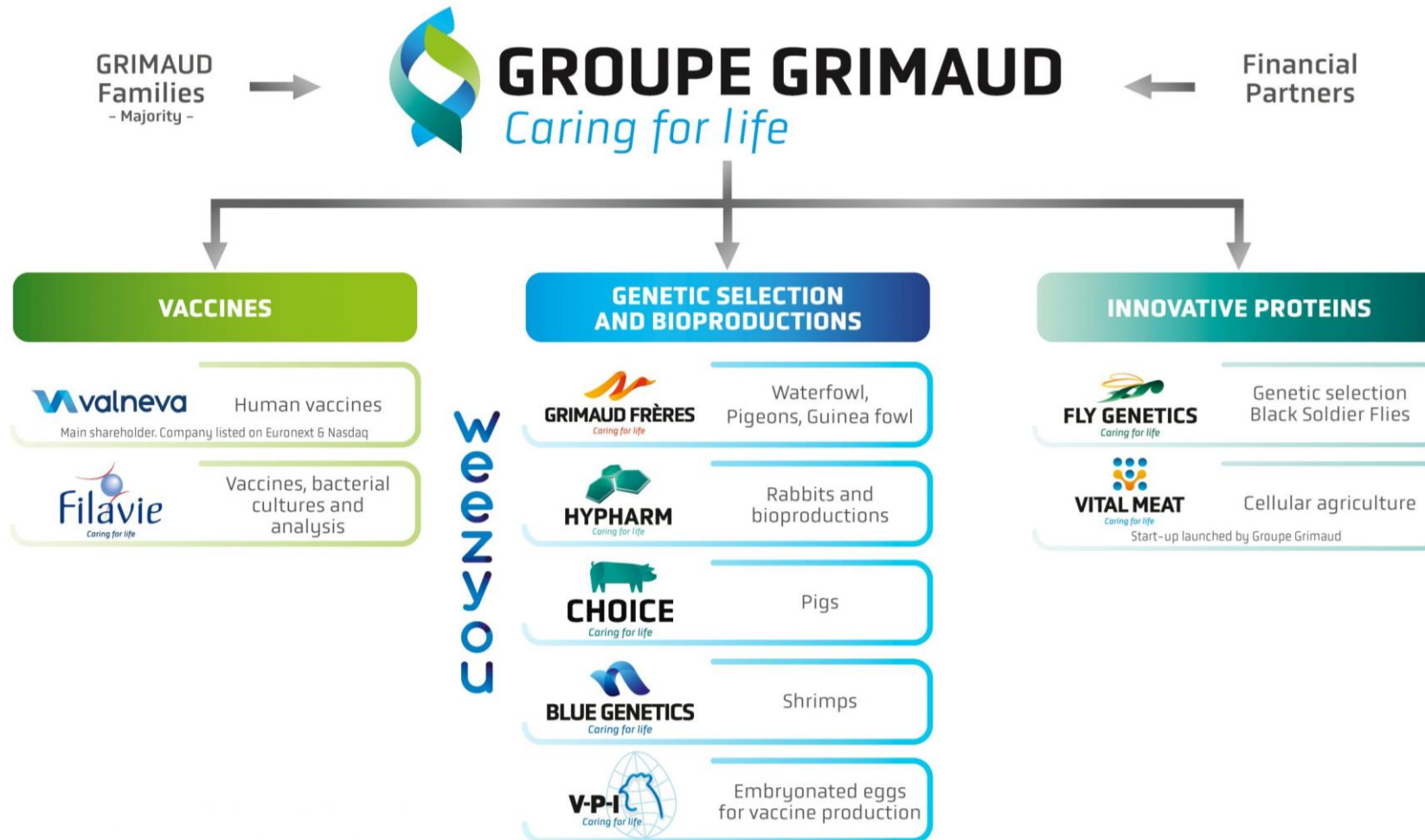
# Overview of poultry breeding companies

- International leaders:

















# Overview of poultry breeding companies

- International leaders:













# SYSAAF member breeders

	Groupe	Selected species	Market(s)
		<i>Gallus</i> broiler	World
		<i>Gallus</i> layer	World
		Ducks, geese, pigeons	Europe-Asia
		Guinea fowl	France-Italia-world
		<i>Gallus</i> layer	World
		Turkey	France-World
		<i>Gallus</i> Broiler	France-World



## SYSAAF member breeders

	Group	Species	Market(s)
<b>Gourmaud Sélection</b>		Ducks, geese	Europe-Asia
		Pheasant, partridge	France-Europe
		Quail	France-Spain-World
		Quail	France-World
	-	<i>Gallus</i> Broiler	France-Europe

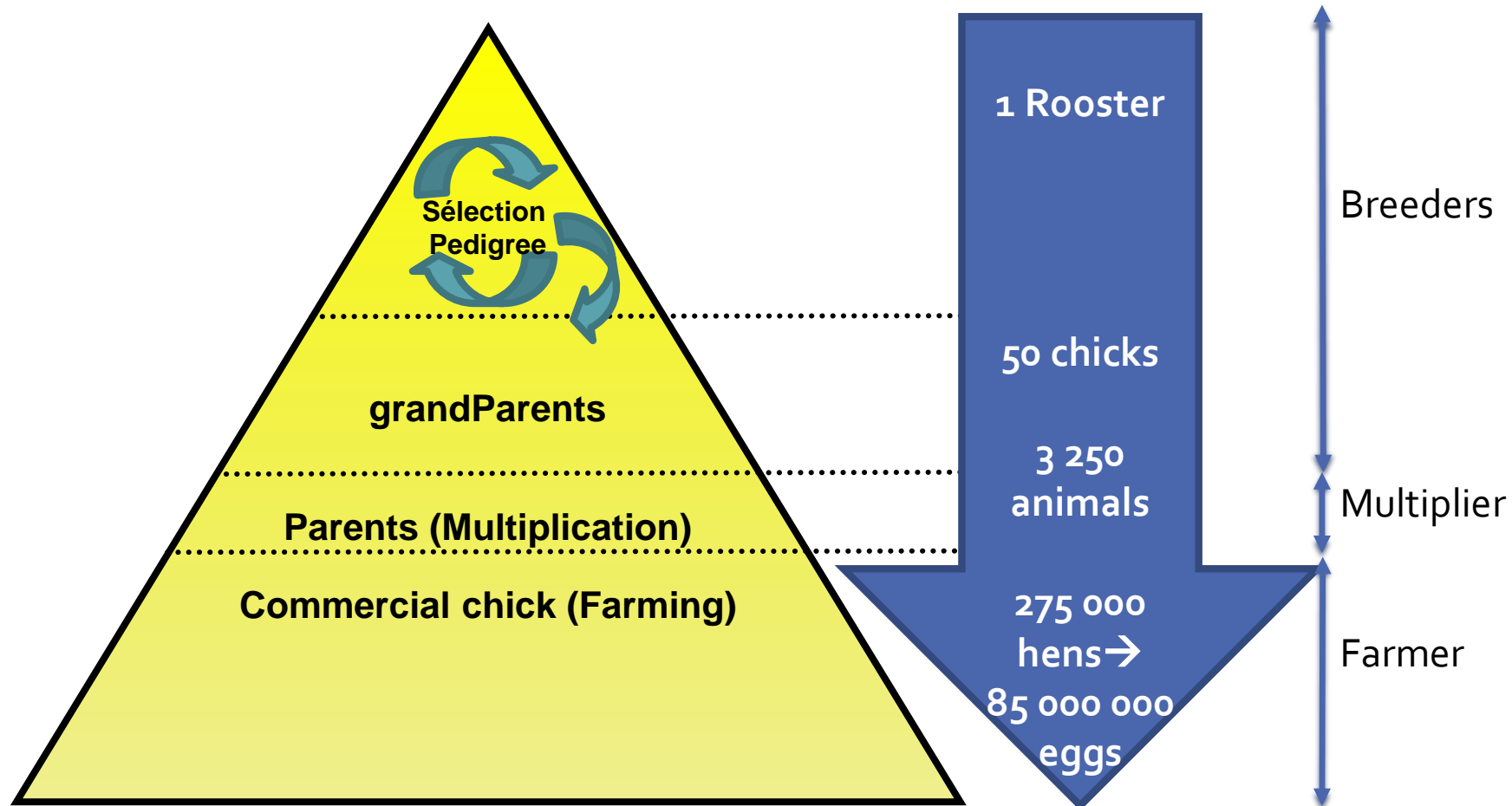


# Avian Breeding

Specific features of the pyramid scheme

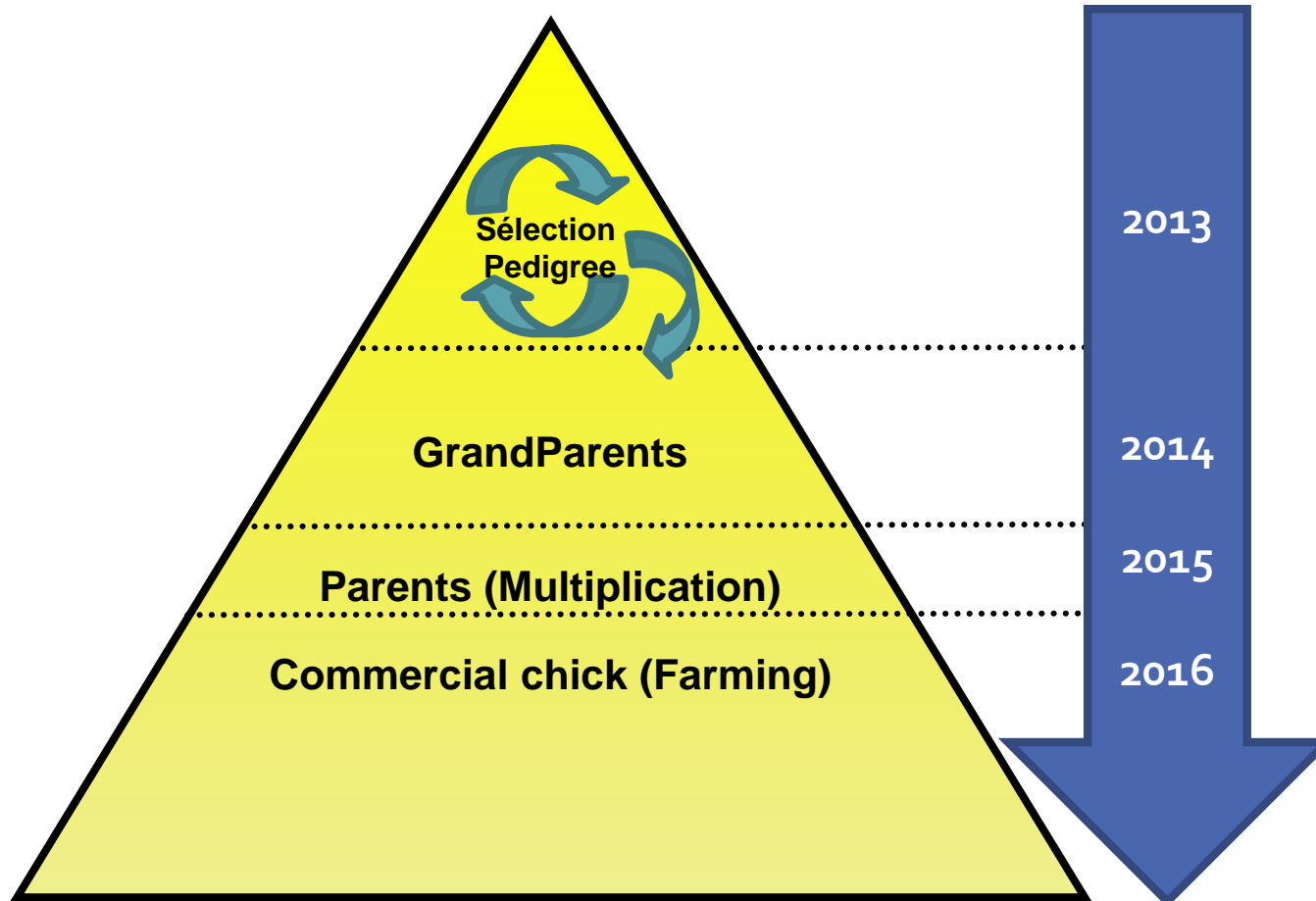
## A very wide distribution...

- 1 rooster selected: 85,000,000 eggs on the market



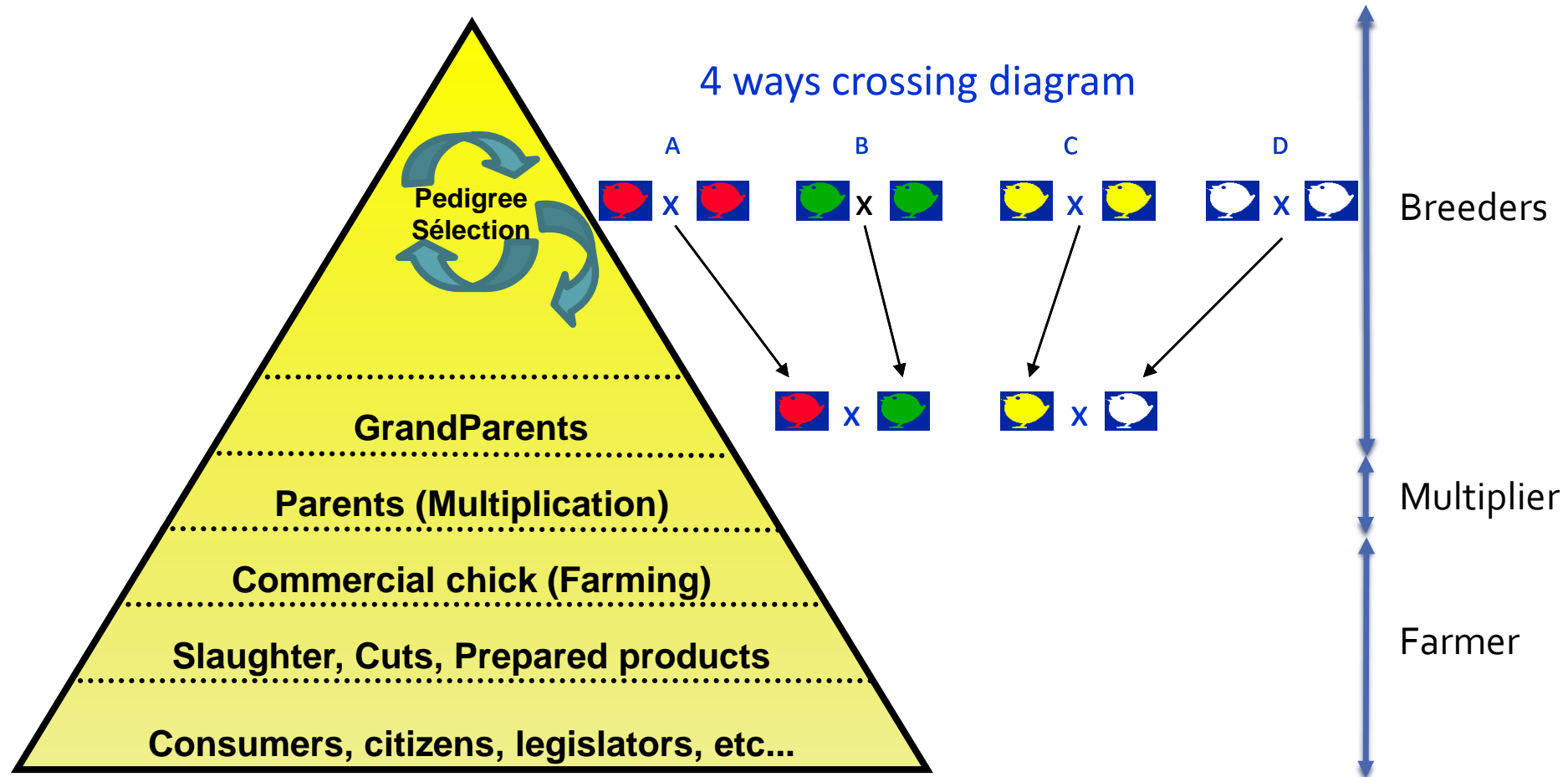
... but long

- It takes 3 to 4 years for genetic progress to be disseminated



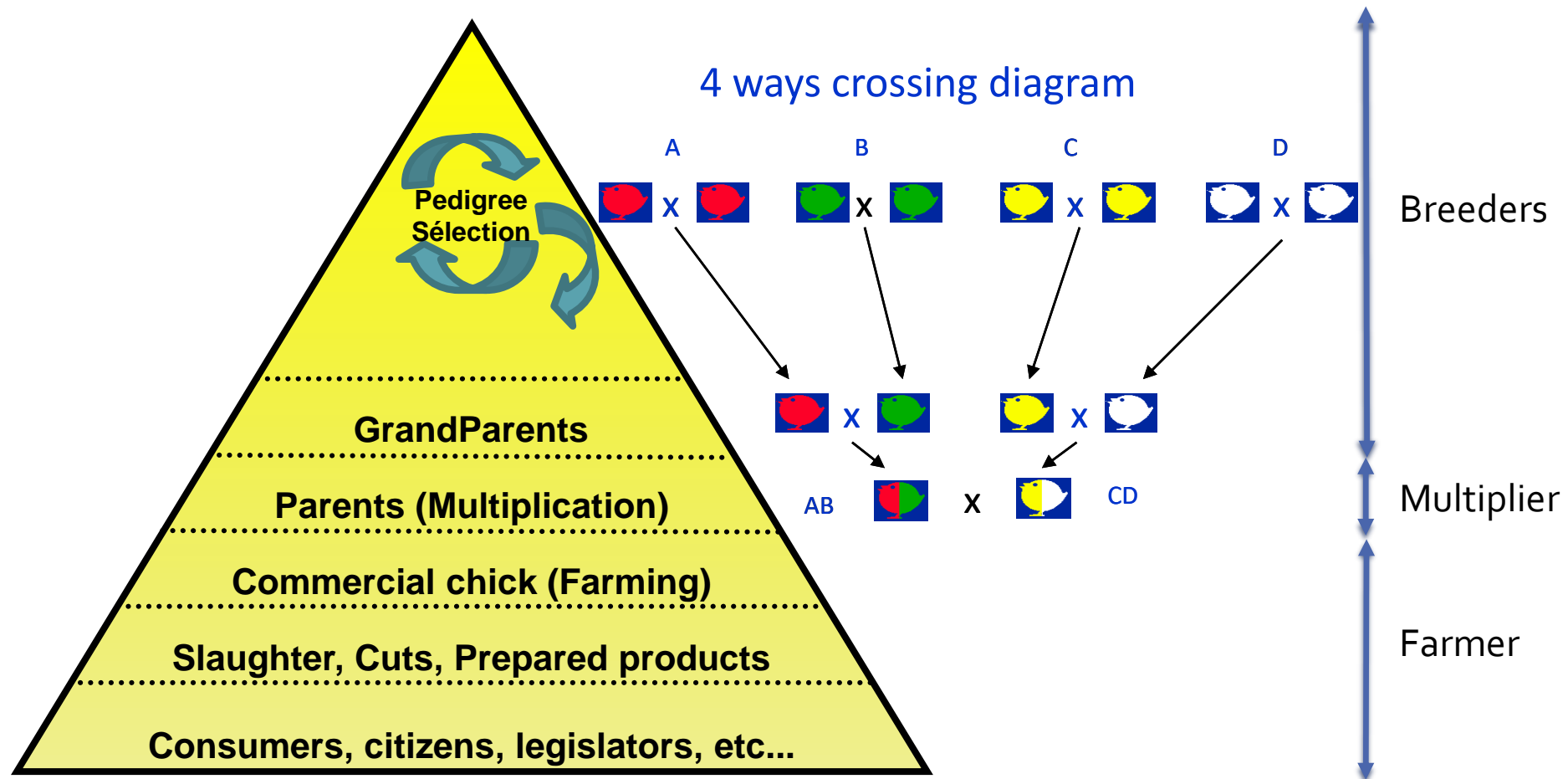
## Pyramidal organisation and crossing

- Breeders improve populations known as "pure breed"



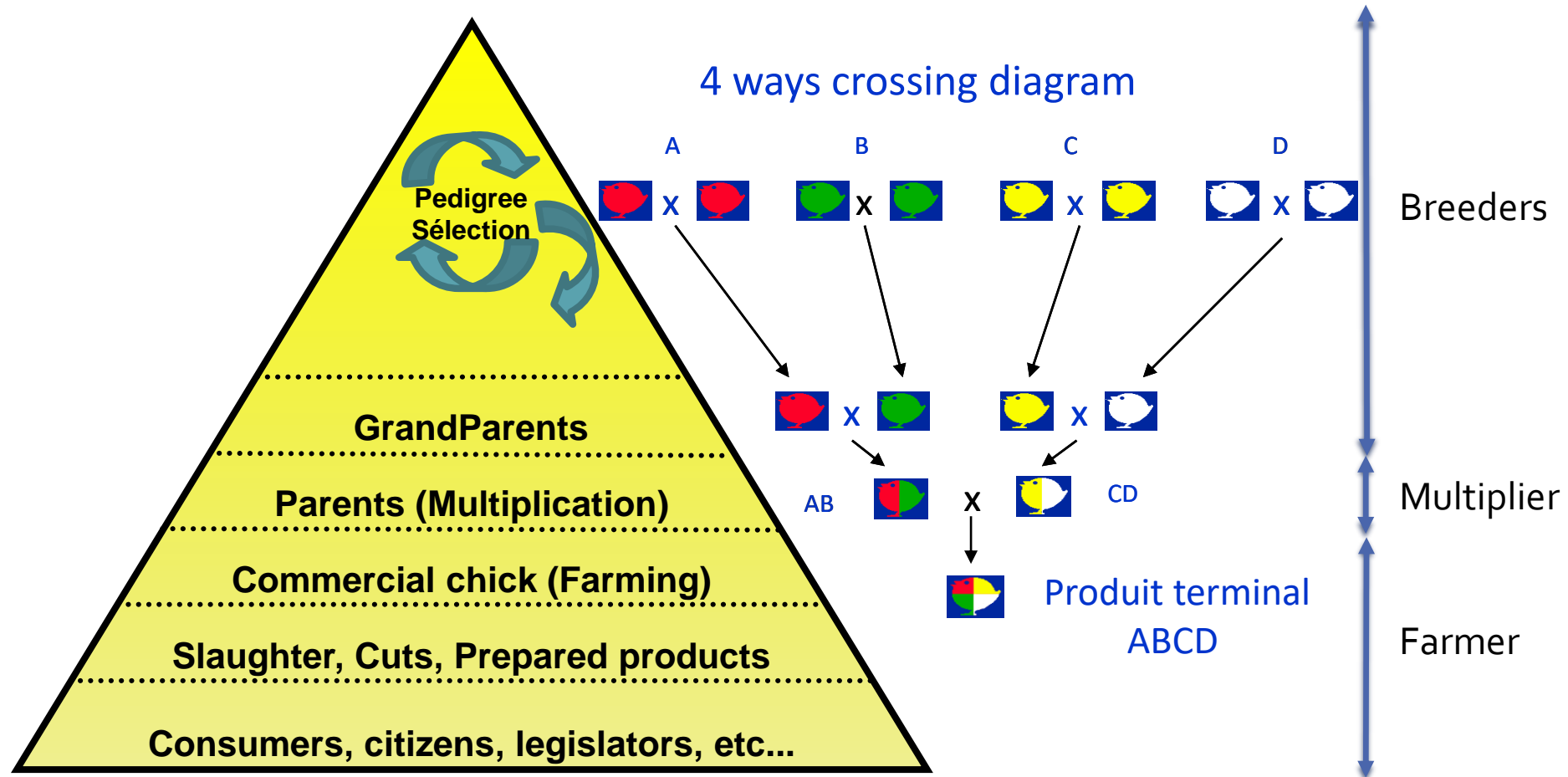
## Pyramidal organisation and crossing

- Pure lines are crossed to obtain parents



## Pyramidal organisation and crossing

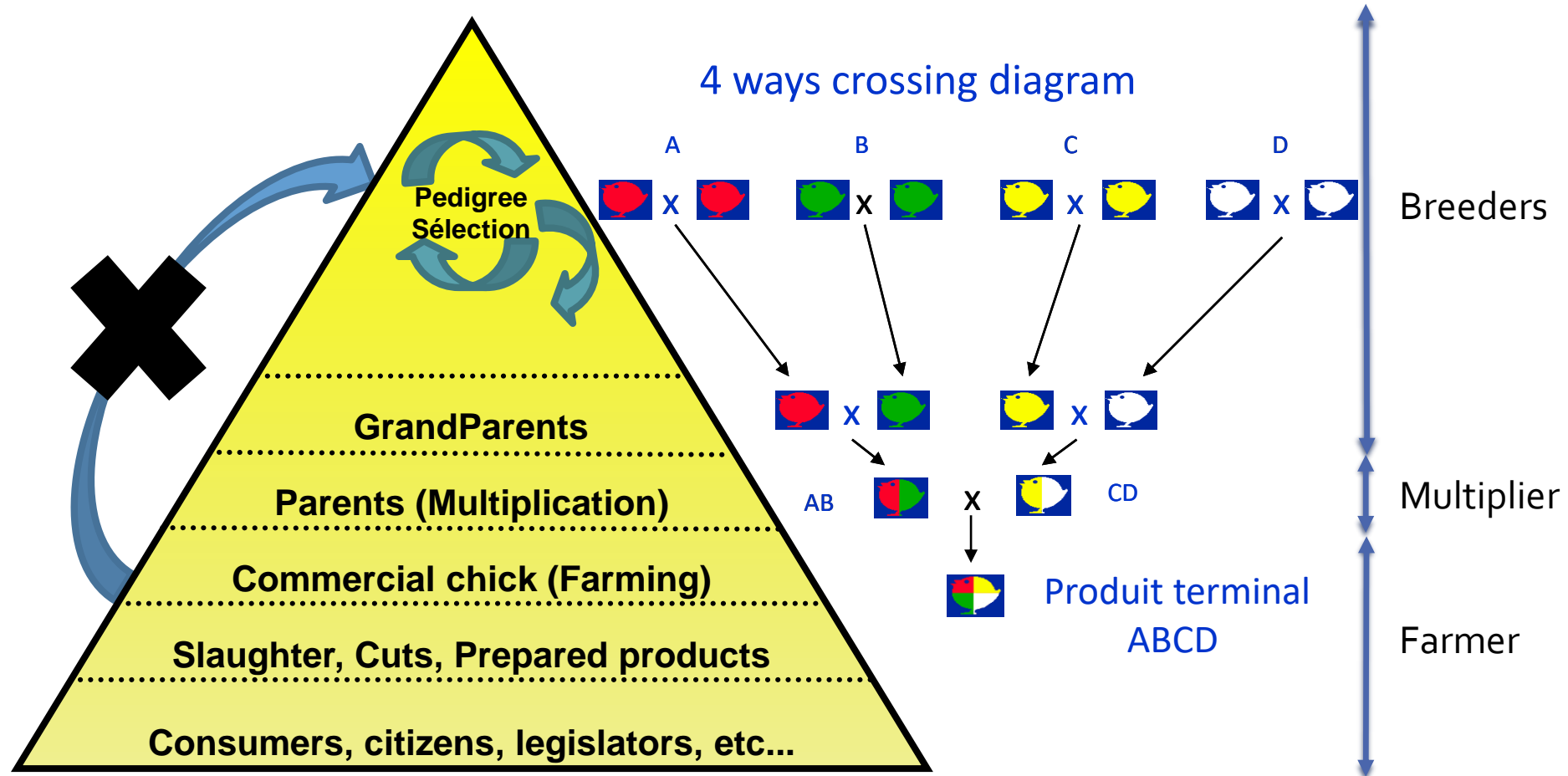
- The commercial end product is the result of a 4-way (or 3-way) crossover





## Pyramidal organisation and crossing

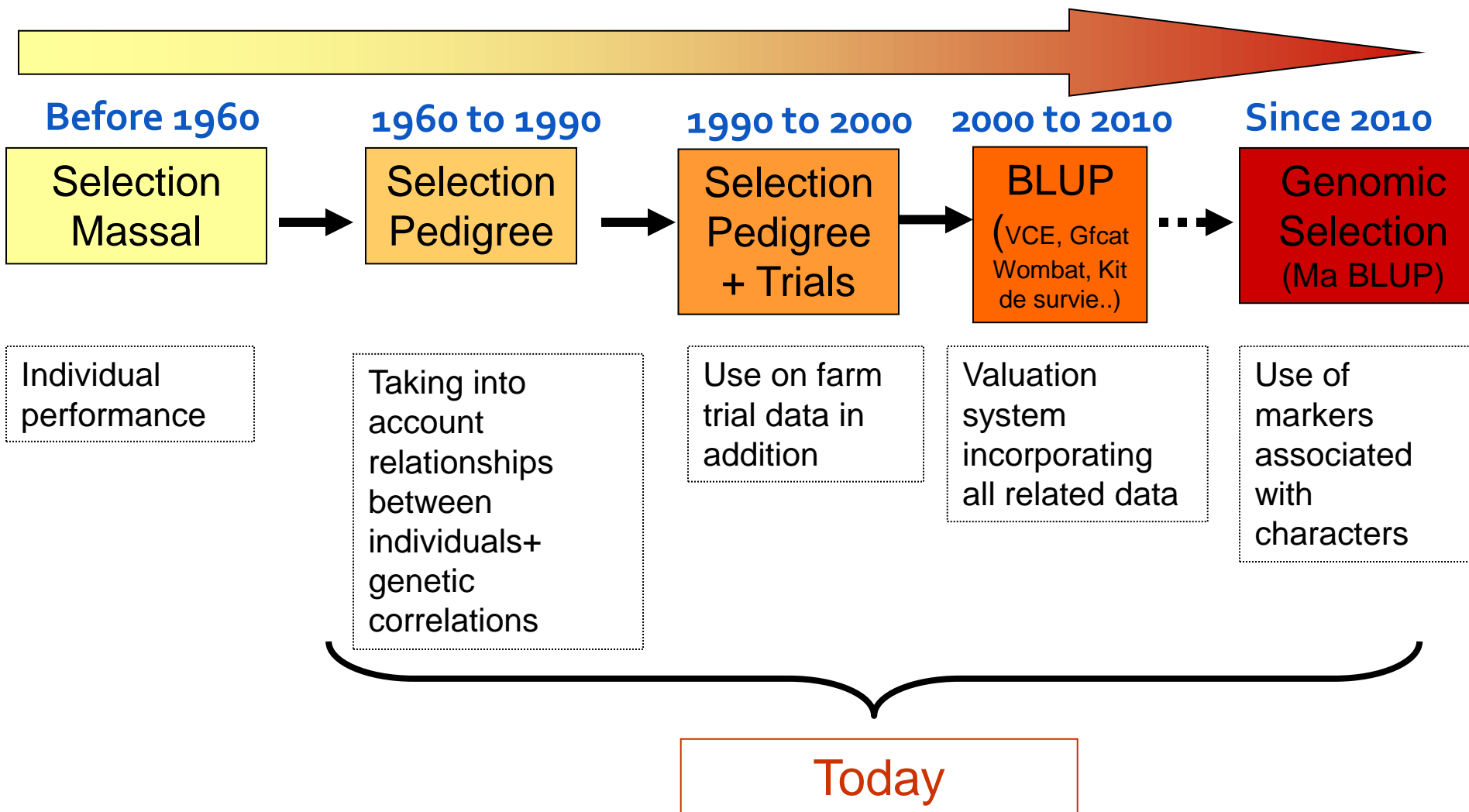
- The only measurements available are those carried out by breeders on their pure breeds



## Pyramid scheme summary

- Pyramid organisation enables genetic progress to be disseminated very widely.
- Strong competition for breeding companies.
- It takes 3 to 4 years for genetic progress to spread from selection to farmers:  
Need to anticipate requirements in order to define selection objectives.
- Breeders work on pure breeds.

# Genetic Evaluation Methods



# How is done the breeding ?

Example of pedigree selection

Phenotyping animals

## Breeding companies select their selection objective

- Depending on the sector, selection is made for production and reproduction traits:
  - Growth rate
  - Meat yield
  - Laying rate
  - Egg quality...
- New challenges:
  - Food efficiency
  - Meat quality
  - Laying persistence
  - Disease resistance
  - Laying in nest ...

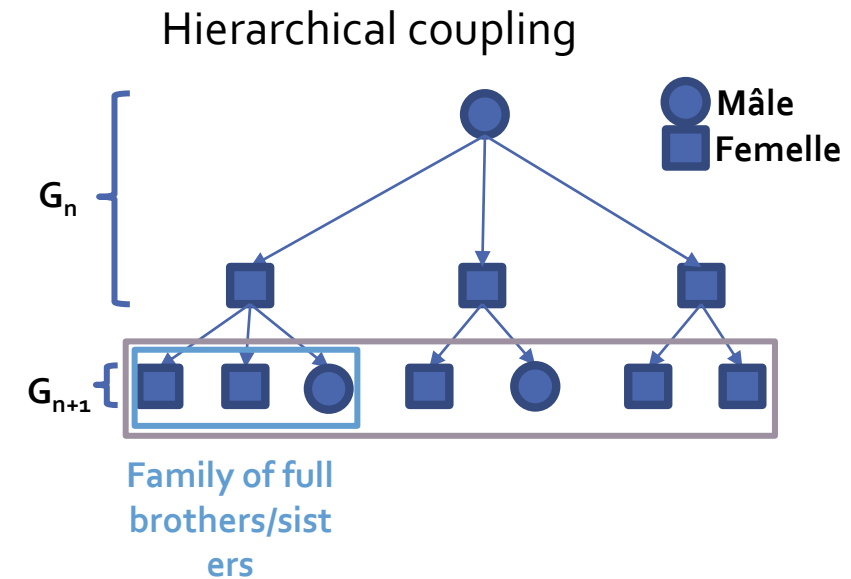
Pure lines are reared in breeding company-specific selection centers.



## Adults are kept in individual cages

- A "pen" is made up of a male and the females assigned to him for reproduction.

Identifying the breeding « pen »

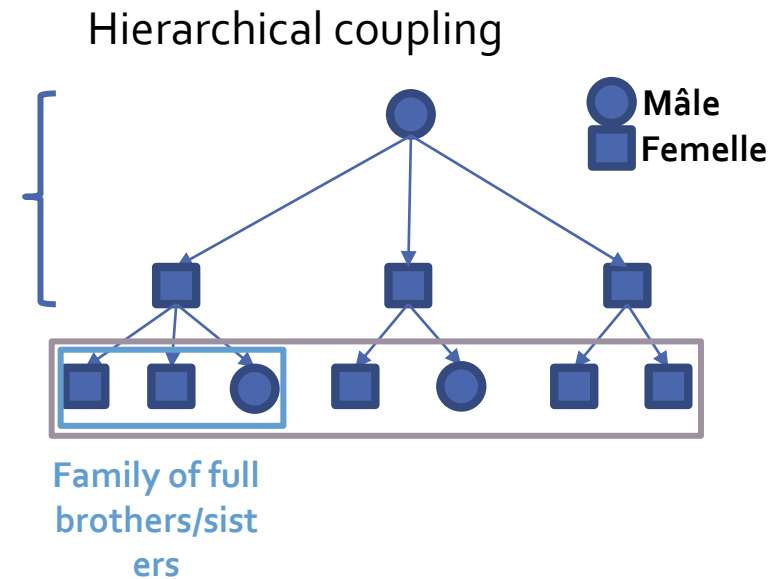


Each breeding hen is inseminated with the semen of a single cock.





Each breeding hen is inseminated with the semen of a single cock.



The eggs are collected from each hen, identified (hen or cage number) and stored in a cool place.



Cage number

Receiver for egg collection



The eggs are placed in an incubator and mirrored after 2 weeks.

Automatic turning



Fertilised egg



Unfertilised egg



All the fertile eggs from the same hen are grouped together in the same basket to finish their incubation.



The hatching is organised into several stations



Chicks from the same hen hatch in the same basket: chick - hen correspondence



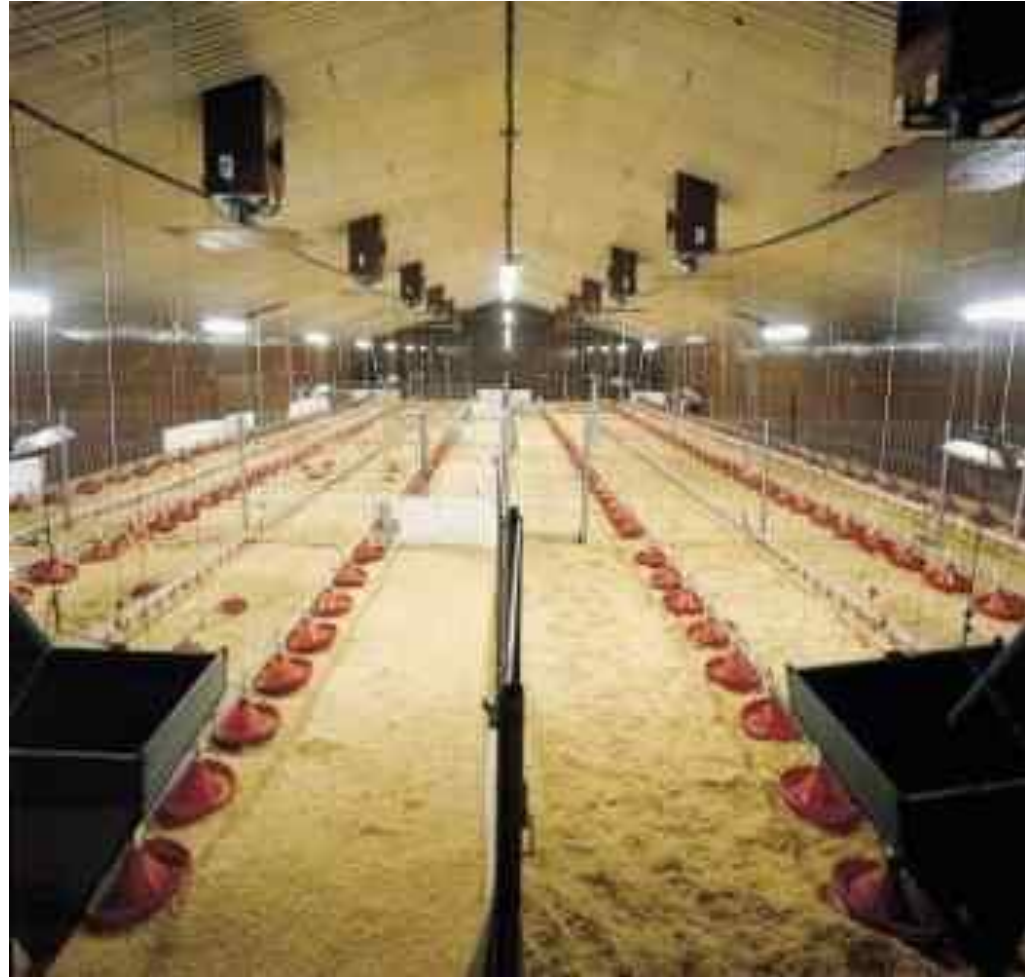
## Pedigree selection

The chicks are immediately identified with a wing band.



### Buildings dedicated to rearing the chicks

The 1st phenotypes and knowledge of the pedigree enable a 1st genetic evaluation to be made.





## Pedigree selection

E.g.: weighing of individuals. Update of sex and mortality.



## Pedigree selection

The rings of young animals are read. Individuals to be kept are caged.



Buildings are dedicated to rearing adults



Cage number

Receiver for egg collection

Animal selection involves identifying male and female breeding stock with the highest estimated genetic values.

to improve the growth and/or production performance of animals that produce animal protein.

### **.How is it carried out?**

Selection is based on observations of animal performance. Selection requires individual recording of different performance parameters.

Once this data has been collected, the results of these performance parameters are analysed.

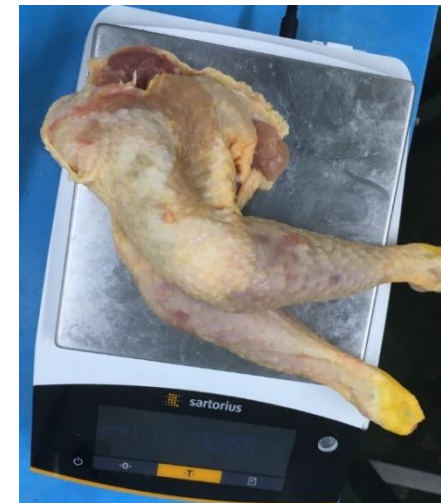
Animals with the best results are chosen to breed the next generation

it carries the improvements for subsequent generations.

This work results in the creation of a "selection scheme"

# Which selection criteria ?

- The adult measurements are carried out according to the selection objectives



# Egg Quality

- Goog Egg Quality until the end of production

Egg Size



Shell Color



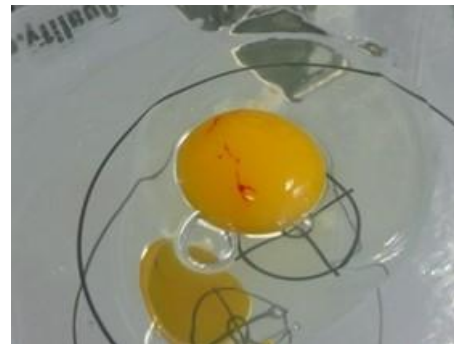
Shell Strength



Haugh Unit



Meat & Blood spots

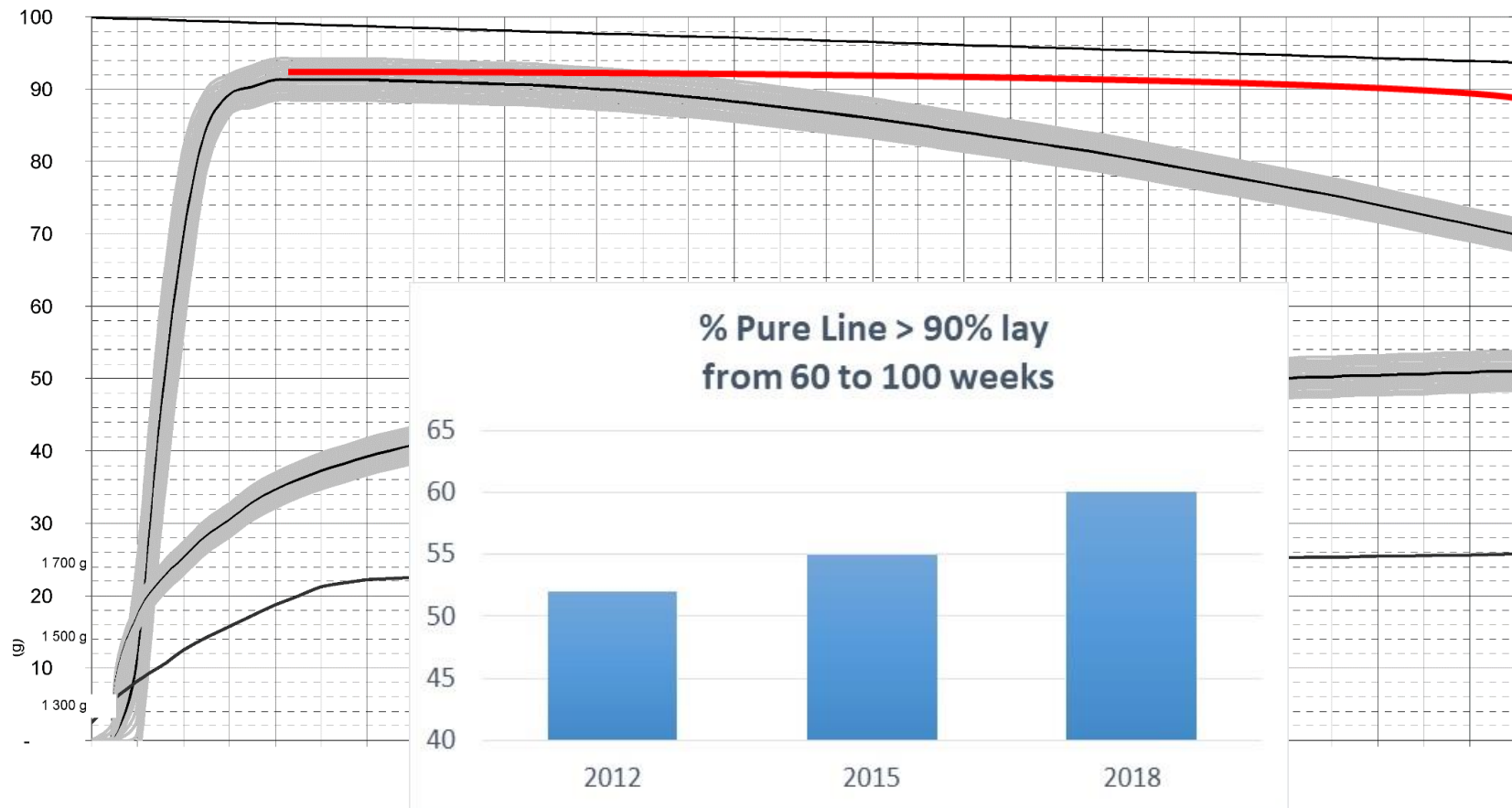


Dry Matter



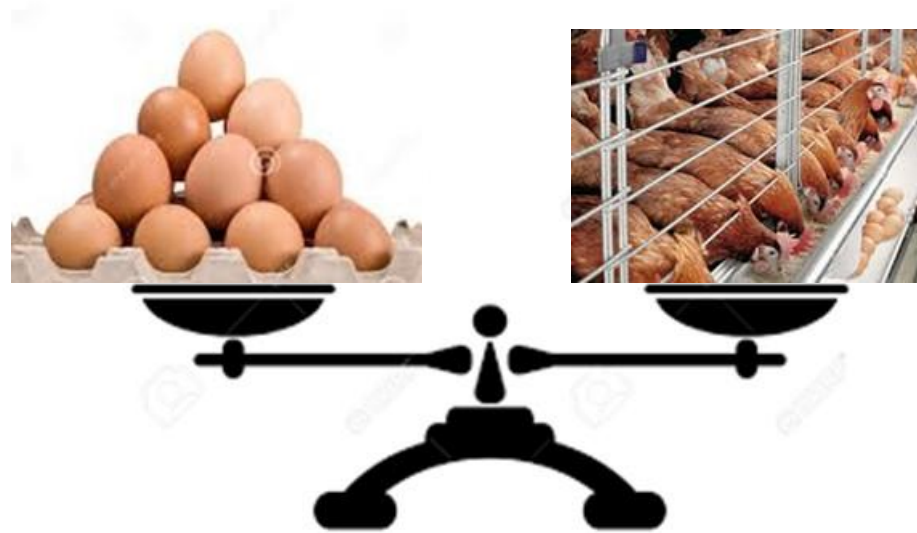
# Productivity and Persistency

- Persistency improvement → Longer Production cycle



## *Breeding on feed efficiency*

Selection on Egg Number  
→ Peak & Persistency  
improvement



Selection on birds ability to  
adapt their feed intake to  
different conditions (feed,  
environments...)

Goal : Increase egg number while preserving feeding capacity



## *Social & Calm Behavior*

- Social behavior
  - Collective Cage / Full Beak birds

Challenges on full beak birds

(Lighting, T°, raw material & Feed presentation)



Peaking behavior measurement



Selection of calm families



## Laying Behavior

### Laying behavior

- Pen Selection in real conditions of production
- Individual Information through RFID technology



### New breeding criteria:

Laying rate in the nest

Laying time

Time inside the nest

Interval between 2 ovipositions

Bird's behavior



### In relation with:

Shell strength

Egg size

Egg shape

# *Meat yields*



## *Meat quality*

- Color
- pH
- Tenderness



# Evolution of genetic selection

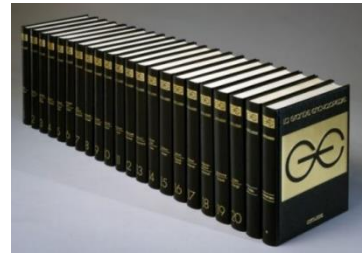
to meet citizen expectations



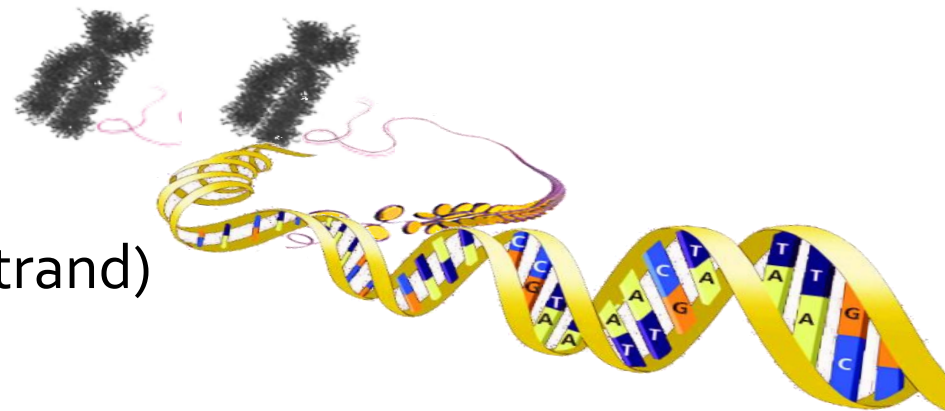
**Genomic selection**

## A few reminders about DNA

- Genetic: transmitted by parents via DNA, compacted into chromosomes.
- DNA can be considered as long TV show, divide into several episodes known as chromosomes.



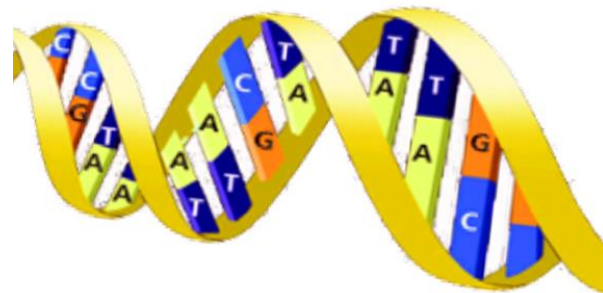
- Chromosomes come in pairs, and the total number of chromosomes varies from one species to another.



- One chromosome = 2 alleles (strand)

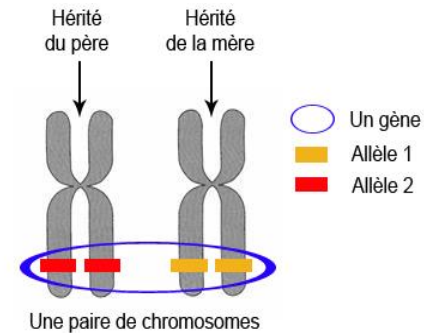
## DNA: secure instructions, written in a universal language

- The 2 strands actually carry the same information (like a security safeguard): A always faces T, C always faces G
- The letters ATCG (nucleotide) are found in the DNA of all living things.
- These letters have the same meaning in all living things: we speak of a universal genetic code.



## Passing DNA from one generation to the next

- Within each pair of chromosomes, one has been inherited from the father, the other from the mother.



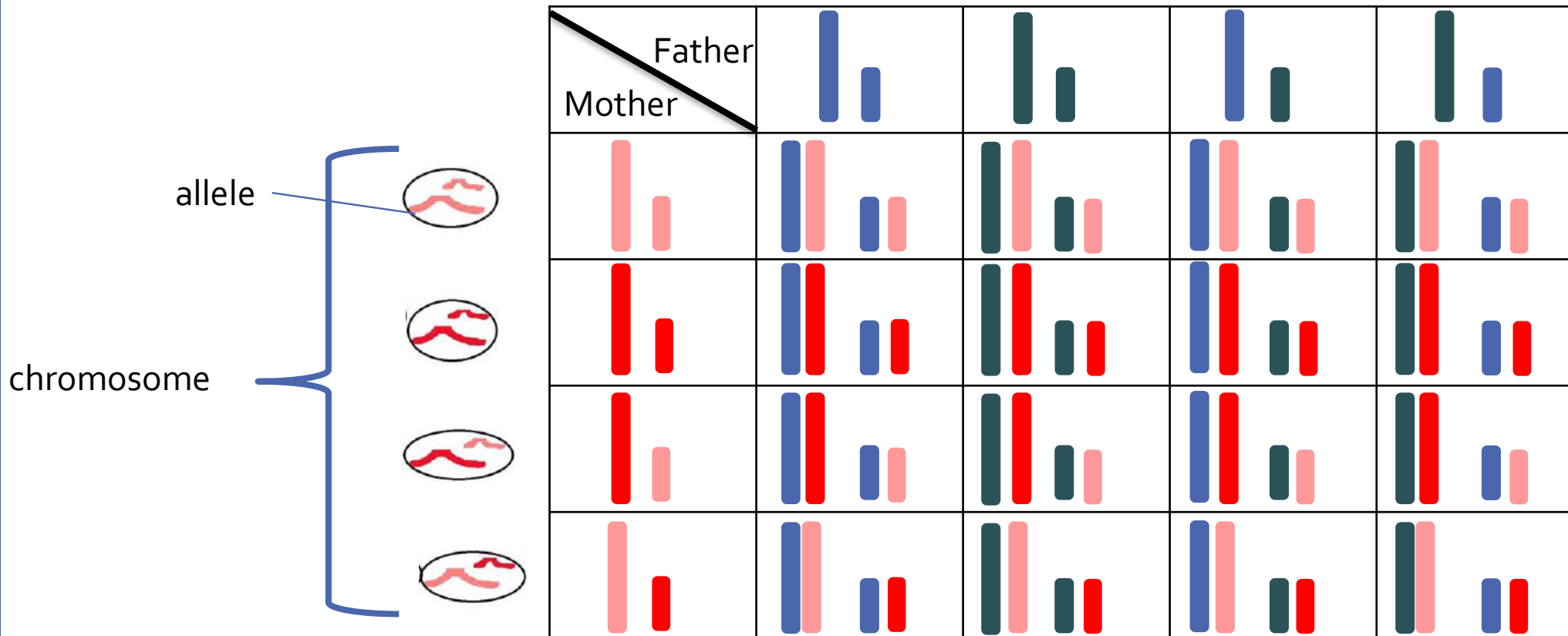
- At the time of reproduction, the father and mother each pass on one chromosome from each pair, i.e. half their genome... but which half?





## Passing DNA from one generation to the next

- The multitude of possible combinations explains the diversity that can be observed within a family.



## Genomics provides access to the genetic code (DNA)

- SNP (Single Nucleotide Polymorphism) markers: single polymorphism of a letter (A, T, C, G).
- A SNP occurs when, in a long series of nucleotides, only one is variable
- We generally work with bi-allelic SNPs: for which there are only 2 possibilities (versions).

Individu 1 : ...ATTTGACCTGATGAC**A**CCTGTAATGTTTTT...

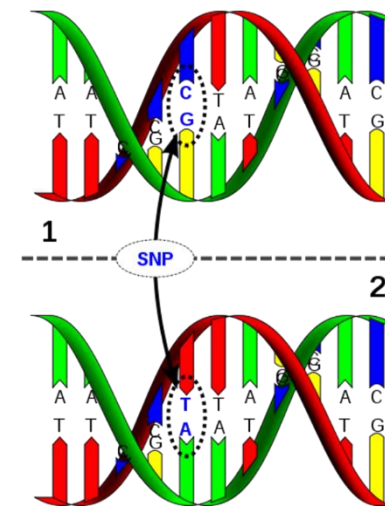
Individu 2 : ...ATTTGACCTGATGAC**C**CCTGTAATGTTTTT...

Individu 3 : ...ATTTGACCTGATGAC**A**CCTGTAATGTTTTT...

Individu 4 : ...ATTTGACCTGATGAC**A**CCTGTAATGTTTTT...

Individu 5 : ...ATTTGACCTGATGAC**A**CCTGTAATGTTTTT...

Individu n : ...ATTTGACCTGATGAC**C**CCTGTAATGTTTTT...



## The genomics revolution: access to the genetic code.

- SNPs are used as DNA markers: bookmarks in our instructions.
- SNPs are obtained by genotyping on a chip.
- Le génotype à un SNP (marque-page) est l'information apportée sur le marqueur. Ici le génotype peut être AA, AC ou CC.

Individu 1 : ...ATTTGACCTGATGAC**A**CCTGTAATGTTTTT...

Individu 2 : ...ATTTGACCTGATGAC**C**CCTGTAATGTTTTT...

Individu 3 : ...ATTTGACCTGATGAC**A**CCTGTAATGTTTTT...

Individu 4 : ...ATTTGACCTGATGAC**A**CCTGTAATGTTTTT...

Individu 5 : ...ATTTGACCTGATGAC**A**CCTGTAATGTTTTT...

Individu n : ...ATTTGACCTGATGAC**C**CCTGTAATGTTTTT...

## The genomics revolution: access to the genetic code.

- A chip is a reading tool that searches for SNPs from a pre-established list, and looks for each individual and each SNP to see which versions it carries.
- How: the flanking sequences of the polymorphism hybridize to the chip by complementarity. A different level of fluorescence is measured according to the allele(s) present.
- A chip can contain from hundreds of SNPs to hundreds of thousands of SNPs.
- The chips are species-specific.



# Genomic selection

- Time saving in the selection scheme  $\Rightarrow$  the cycle is shortened.
- allows animals to be reared on the ground
- group of animals with male and female  $\Rightarrow$  1 male for 5 females
- Natural reproduction / Female lays in nest
- Blood samples taken from chicks:
  - Possibility of classifying individuals within siblings (e.g. roosters for egg-laying)
  - We will be able to look for the best individuals in different families: preserving genetic diversity.

## The limits of selection

Want to improve the performance but there is physiological limits

Example : broiler faster growth can induce :



White striping



Wooden breast

Breast Muscle Myopathy



Spaghetti meat

The most commercialised genotype in layers and broilers

## Layers

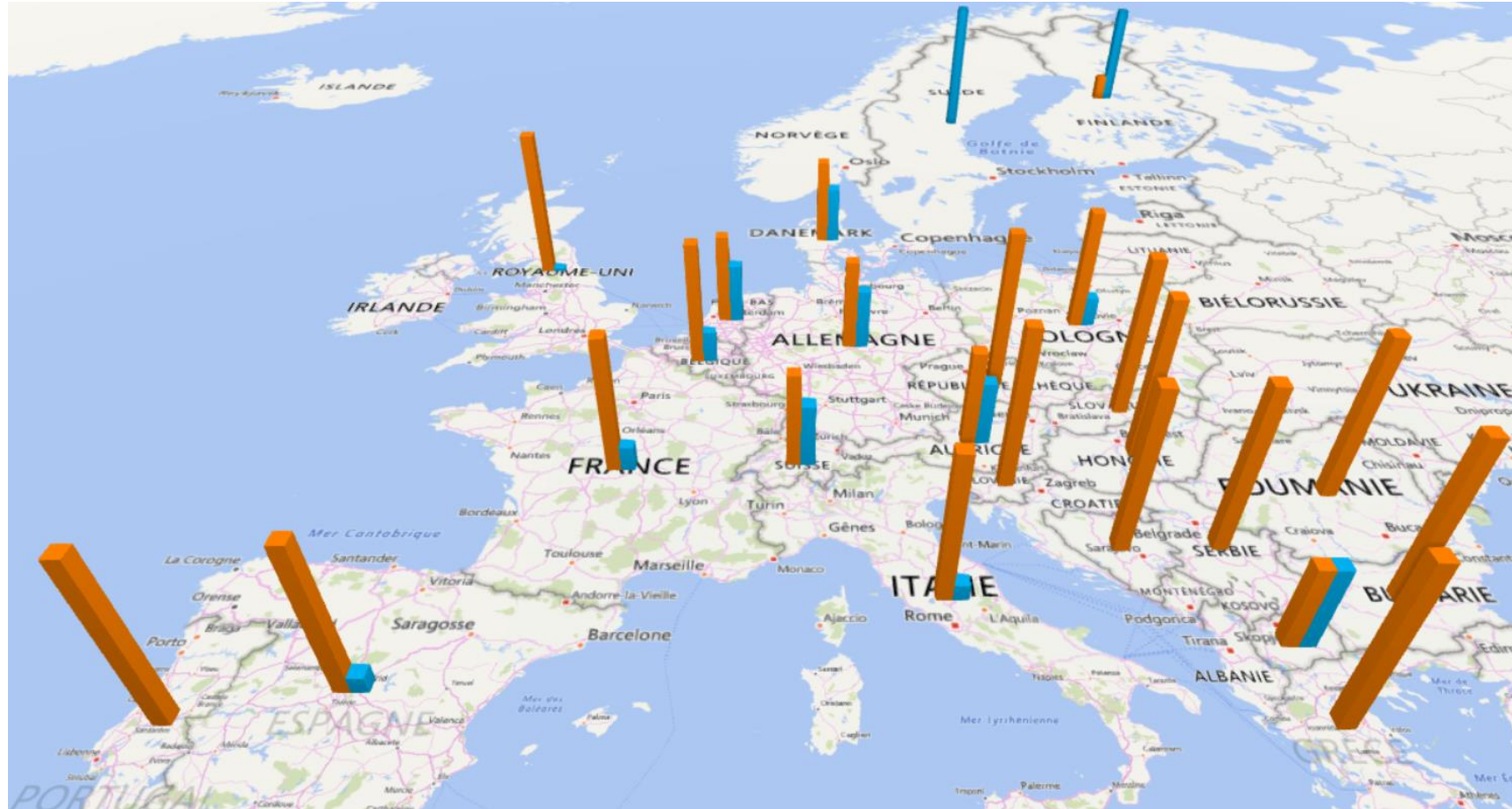
### 3 genotypes for layers

- Brown eggs (Rhode island)
- White eggs (Leghorn)
- Local breed ( ex: marans with chocolate eggs)



# Layers : white & brown eggs

In US  
majority of  
white eggs



Leghorn



White



Brown

Rhode island



# Broilers

2 main categories:



Rapid growth (also known as conventional)

Slower-growing alternative products

Rapid growth accounts for the vast majority of volumes  
(~**97% worldwide; 91% in Europe**)

Production based essentially on performance: growth, feed efficiency and meat yields.

# Broilers

2 main categories:

- Rapid growth (also known as conventional)
- Slower-growing alternative products



Slower growth, = a small volumes in many countries.

Products characterised by a specific phenotype and a particular set of specifications.  
local breeds, organic, label (red or other), farmhouse, certified chicken.

Answer to demands for more local produce, animal welfare and quality, even if the economic crisis (war in Ukraine, inflation) has slowed the momentum.

**The major weakness is the higher production price compared with conventional chicken: from +15% to +200% ...**

**What about environmental impact ?**

Autumn school *October 25-26, 2023*



Thank you for your attention





Thank you for your attention

Maxime Reverchon (SYSAAF)

Autumn school Assisi (Italia)

*(25-27 October 2023)*

