TECHNICAL GUIDE

ACCESS

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GENETIC SELECTION: PRINCIPLE AND ADVANTAGES

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CONTENTS

1. PRINCIPLE OF GENETIC SELECTION

The objective of genetic selection is to improve the performance of a population of animals for one or more criteria of interest. In animal genetics, the criteria of interest are chosen according to zootechnical principles intended to improve the technical and economic performance of farms.

The first step in achieving an efficient genetic selection is to know all the individuals present in the selected population: they are all identified and it is possible to link them together, this is called the genealogy or pedigree.

The second step consists of measuring the criteria of interest that we wish to improve, such as prolificity*, weight at a given age, growth or the resistance of the animals to certain diseases*.

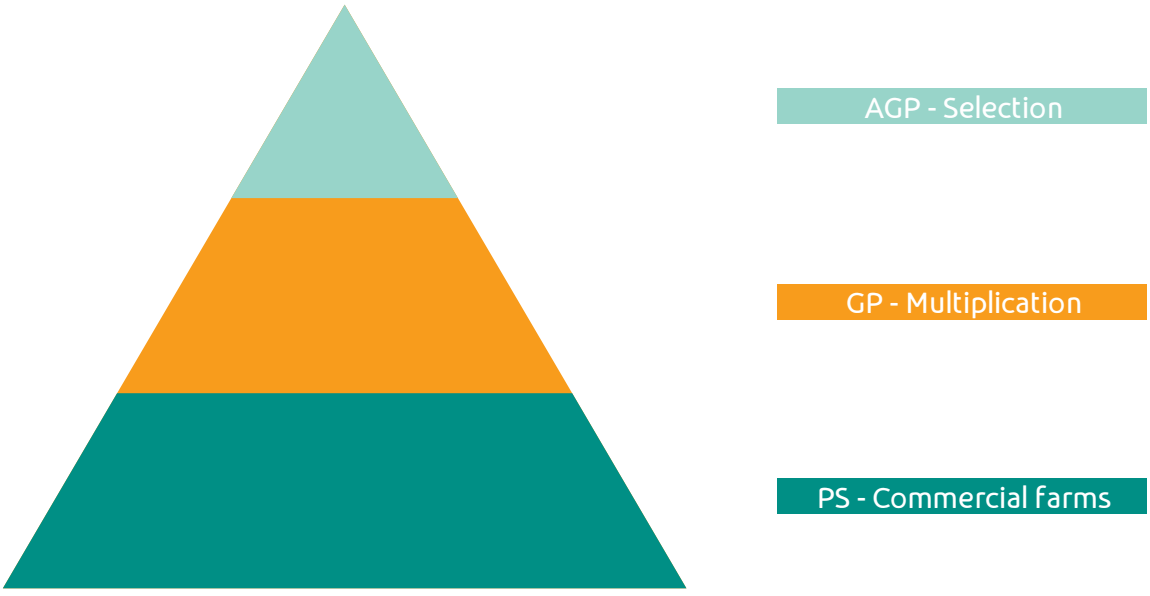
Then, by putting together all the information collected, it is possible to identify the individuals who improve the desired criteria by means of a score. Thus, by selecting and then breeding the improving animals, the whole population enters into a process of continuous improvement to progress on the chosen genetic criteria, which also improves production results.

2. BASIC PRINCIPLE OF GENETIC DISSEMINATION

In order to distribute the selected products, males and females, the selection companies have a pyramid system, in which the selection herds are at the top and the breeding animals intended for introduction into the commercial farms are at the bottom. In order to increase the number of available production animals, there is an intermediate stage called multiplication.

At each level the breeders have a name to differentiate them:

- **AGP** for great-grandparents at the level of selection lines
- **GP** for grandparents at the level of multiplication, or commercial farms when their size is sufficient (see Breeding management: Renewal modes)
- **PS** for parent stock.



* see glossary

3. GENETIC SELECTION "BY" HYPHARM

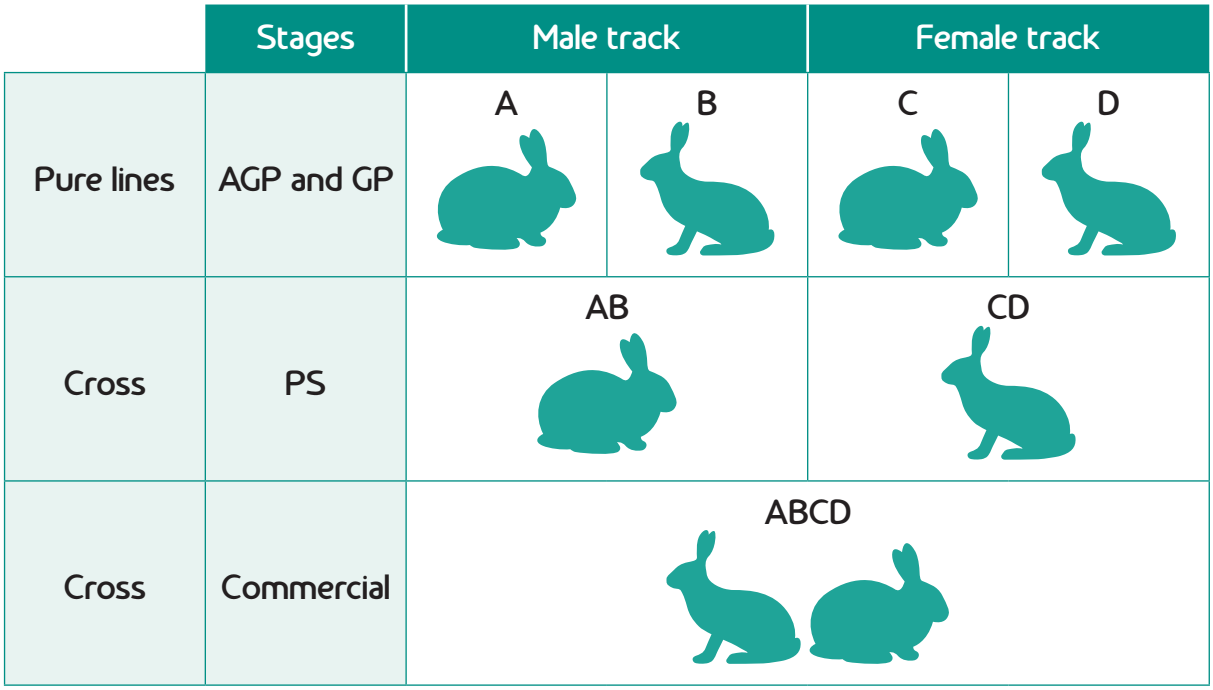
At Hypharm, the principle of genetic selection is used for the selection of pure lines selected on production criteria of technical and economic interest for the sector and to meet the expectations of breeders.

These pure lines are divided into two blocks also called lines, with 'female' lines on one side and 'male' lines on the other. The selection of 'female' lines is oriented toward maternity production to improve the performance of breeding rabbits, while the selection of 'male' lines is directed toward criteria related to the improvement of the weight of the animals, their growth, their carcass yield* and their digestive stability in the fattening phase.

The selection work on pure lines is completed by a cross strategy in order to cumulate the selected traits on each base line, to avoid inbreeding, but also to benefit from the heterosis* effect.

This selection method makes it possible to combine and optimize a large number of criteria to find the best cost price per kilo of carcass, in the largest number of breeding models.

Furthermore, as it is difficult, if not impossible, to select on reproductive performance criteria and on butchery performance criteria on the same animals (lines), most commercial schemes propose '4-way' crosses as illustrated below.



The Hypharm C and D female lines are selected to improve maternal traits in order to obtain the highest number of quality weaned young rabbits per litter. This is associated with the search for optimal viability of the females in production and good longevity* in their reproductive career. The selected breeding criteria are: fertility*, prolificacy*, persistence*, longevity*, milk production*, homogeneity* of litter size, homogeneity* of weight of the young and resistance to infectious problems*.

* see glossary

4. SELECTION SCHEME FOR 'MALE' LINES

In 'male' lines, the objective is to improve the production traits that are measured during the fattening phase of the animals between weaning and sale. These traits have heritabilities* (h2) that are generally higher than the numerical productivity criteria selected on the 'female' lines and therefore theoretically progress more rapidly. These criteria are the growth of the animals, the weights obtained at a fixed age, the carcass yield*. In addition, other qualitative criteria are added such as the resistance* of the animals to digestive problems sometimes encountered in fattening; and also sperm production criteria. Indeed, the males produced are mostly intended to supply the insemination centres to produce semen that will be used to inseminate the GP and PS females in the final farms. The quality and quantity of semen production is the primary objective for IACs.

The art of selecting 'male' lines well involves finding the right mix between the different criteria selected to obtain a balanced genetic progress between performance and viability of the rabbits produced from our males.

Weighting between the different genetic traits measured is used to calculate the selection indexes (VG or EBV) to find this balance.

From the HYPHARM selection, we offer 3 distinct males adapted to different markets:

- The PS59 medium-heavy to extra-heavy: white coat, slaughter 70-84 days
- The PS40 medium: white coat with extremities (legs and nose) more or less tinged with grey, slaughter 60-70 days
- The PS119 medium-heavy to extra-heavy: coloured coat (wild rabbit, grey or brown) slaughter 70-84 days.

* see glossary

hyPLUS

PARENTAL MALE

PS 59

ROBUSTNESS, LIVE WEIGHT AND CARCASS WEIGHT.

Ease of performance: ★★★★★

Growth and yield: ★★★★★

Food efficiency: ★★★★☆

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* see glossary

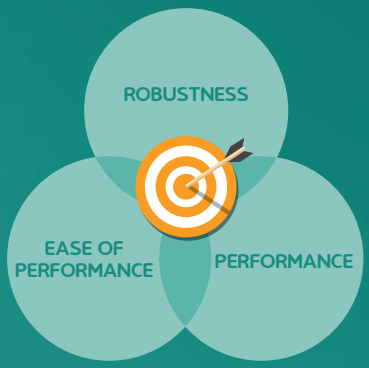
MALE PARENTAL

PS 59

QUALITIES OF THE MALE

- 100% white coat
- Ingestion control and management
- Carcass weight and quality
- Food efficiency

SELECTION FACTORS



EXPERT VIEWPOINT

The male PS 59 is a parental male from white giant breeds. Its selection is based on a slaughter weight between 70 and 91 days, feed conversion ratio and breeding viability, and, mainly, on maximising carcass yield, measured since 1987. These selection efforts make it the best candidate to improve the value of the final product.

Mickaël Maupin and Raphaël Robert
R&D engineers

EXPECTED PERFORMANCE

- High live weight
- **1,300–1,900 kg**
  carcass weight between 70 and 91 days of age
- High sperm production
- Ease of collection

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* see glossary

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PS 40

PARENTAL MALE

ROBUSTNESS, LIVE WEIGHT AND YIELD FOR EARLY SLAUGHTER.

Rapid growth:	★★★★★
Early yield:	★★★★★
Food efficiency:	★★★★☆

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* see glossary

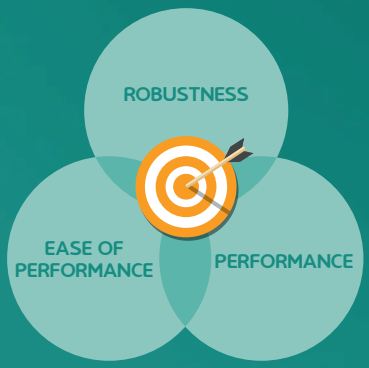
PARENTAL MALE

PS 40

QUALITIES OF THE MALE

- White coat, grey-tipped members
- Ingestion control and management
- Carcass weight and quality
- Food efficiency

SELECTION FACTORS



EXPERT VIEWPOINT

The terminal male PS 40 is the result of a direct cross between the HYPLUS 39 and 59 meat lines. This hybrid male combines the weight and yield qualities of its sire lines to allow for earlier slaughter (63-65 days), while maintaining high sales weight and carcass yield.

Mickaël Maupin and
Raphaël Robert
R&D engineers

EXPECTED PERFORMANCE

- Early slaughter
- 1,000 – 1,100 kg
  carcass weight between 63 days of age
- Sexual precocity
- High sperm production
- Ease of collection

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PARENTAL MALE

PS 119

ROBUSTNESS, CARCASS WEIGHT.
100% COLOURED RABBITS.

Food efficiency: ★★★★☆

Ease of performance: ★★★★☆

Growth and yield: ★★★★★

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* see glossary

MALE PARENTAL

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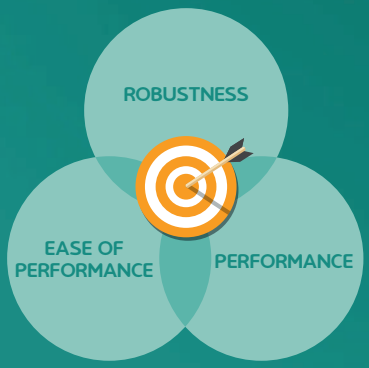
PS 119

QUALITIES OF THE MALE

- 100% coloured coat, black eyes
- Ingestion control and management
- Carcass weight and quality
- Food efficiency

SELECTION FACTORS



EXPERT VIEWPOINT

With the coloured male PS 119, 100% of meat rabbits obtained are coloured and black-eyed. These characteristics make it possible to meet the various specifications for the production of coloured rabbits. In addition, this male is selected on the feed conversion ratio and breeding viability, and also on the quality of the carcasses.

Mickaël Maupin and Raphaël Robert
R&D engineers

EXPECTED PERFORMANCE

- High live weight
- **1,300–1,900 kg**
  carcass weight between 70 and 91 days of age
- High sperm production
- Ease of collection

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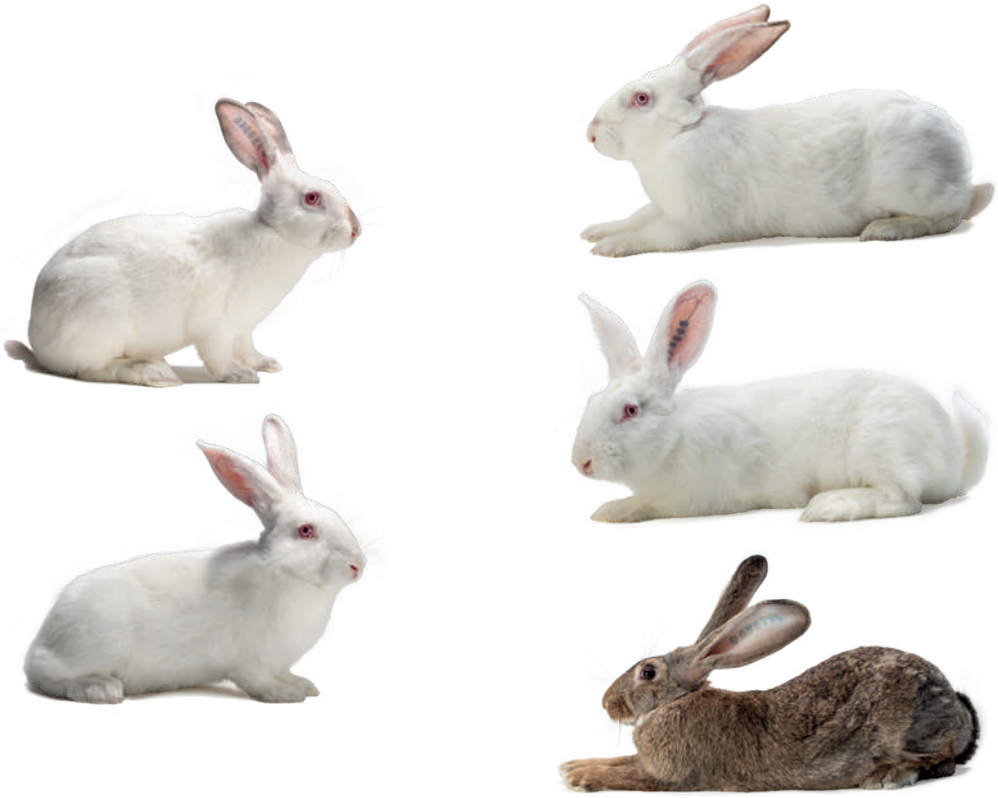

* see glossary

5. GLOSSARY

Fertility: is the ability of a female to produce offspring. Fertility is measured by the ratio of the number of females that have given birth to the number of females that have been inseminated or mated.

Genotype: is the set of genetic traits, or the set of genes expressed by an individual. The genotype is expressed or not in the phenotype of the animal according to the environmental conditions in which it evolves.

Heritability (h2): is the explanatory genetic part of a trait that is passed on to the next generation. The heritability is between 0 and 1. The closer the latter is to 1, the more the genetic part explains the observed performance/phenotype; and the more it is transmitted to the descendants.

Heterosis: it is a well-known principle in genetics, which makes crossed animals superior to their pure line parents, in terms of performance but also in terms of robustness. This heterosis effect is particularly important on criteria that are not easily heritable, and therefore difficult to improve by classical selection methods, such as fertility, prolificity, milk qualities or semen quality.

Weight uniformity: this is a synthetic trait established per litter at birth or weaning by individually weighing all the bunnies in a litter. We are looking to obtain rabbits with similar weights, because their rearing via an allin/allout system is facilitated, and there is less competition between individuals.

Litter size uniformity: this trait is measured for the entire career of a female. The objective is to obtain high average litter sizes but with no gap between individuals to facilitate the work to be done at parturition.

Longevity: is the length of a female's career in production expressed as the number of inseminations or matings performed.

Persistence: is the ratio of the number of producing females still present at a given insemination rank (e.g. 3rd insemination) to the total number of females that were inseminated in the 1st insemination/ breeding.

Phenotype: is the set of appearance, physiological and production traits observed in an animal. In other words, it is the gene expression of an individual in a given environment. For a female, for example, a number of live births per birth is a phenotype, or the weight measured at a given age is also a phenotype.

Milk production: in the 'female' line, the aim is to maximize milk production so that all the youngsters raised by the female have enough milk to ensure their survival and growth until weaning.

Prolificity: this is the trait measured as the number of total or live-born rabbits per female per parturition or sometimes over the entire career.

Carcass yield: is the ratio of hot or cold carcass weight to the live weight of the animal before slaughter.

Resistance to infectious problems: this is a synthetic trait that grades all animals at a given age on the presence or absence of apparent disease (observed symptoms). In this character all symptoms of digestive, respiratory and infectious problems are reported.