INTRODUCTION TO

ANIMAL BREEDING

Lecture Nr 4

The efficiency of selection

The selection programmes

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The genetic gain and its parameters

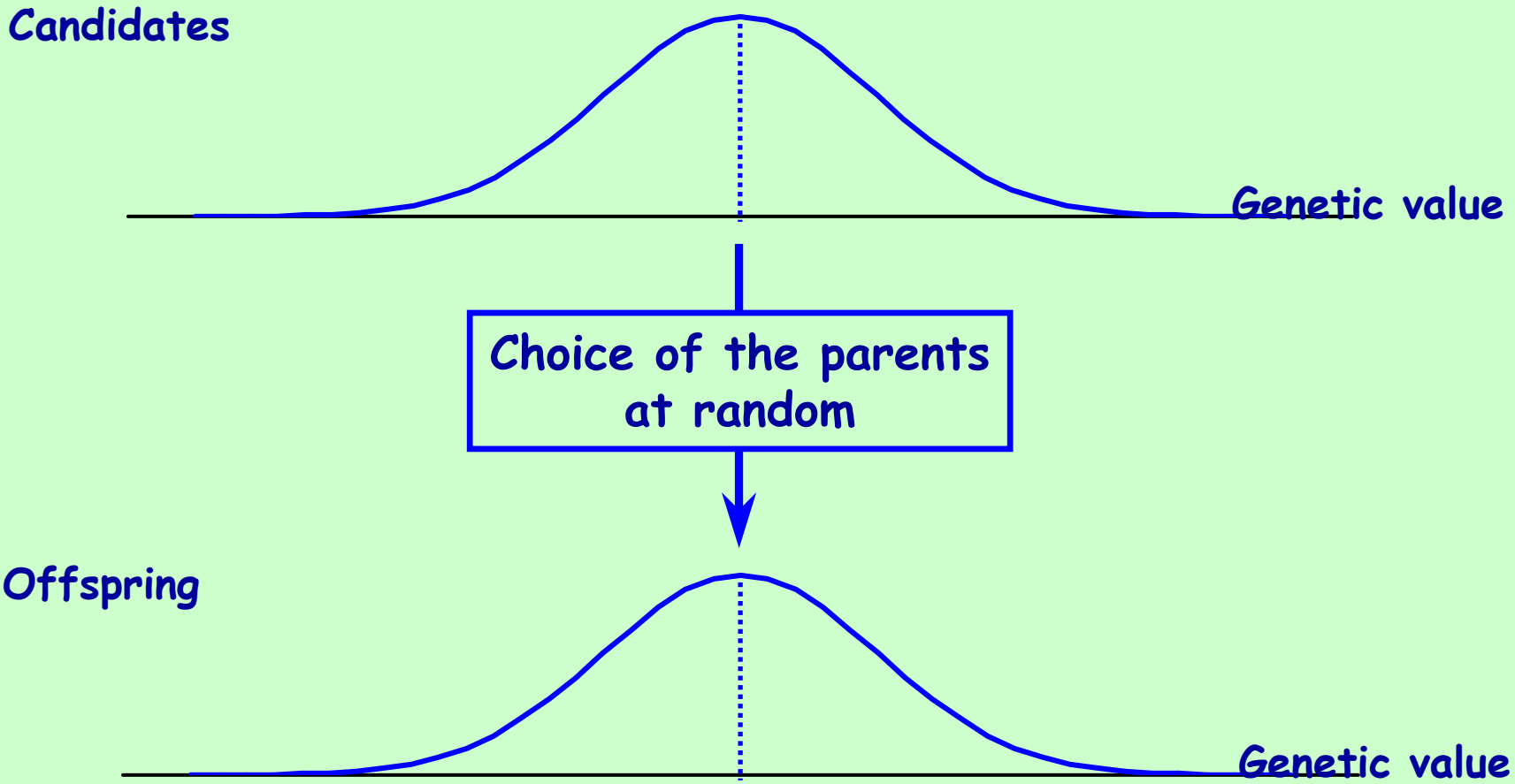
Comparison of the different selection methods

The multiple trait selection

Selection programmes

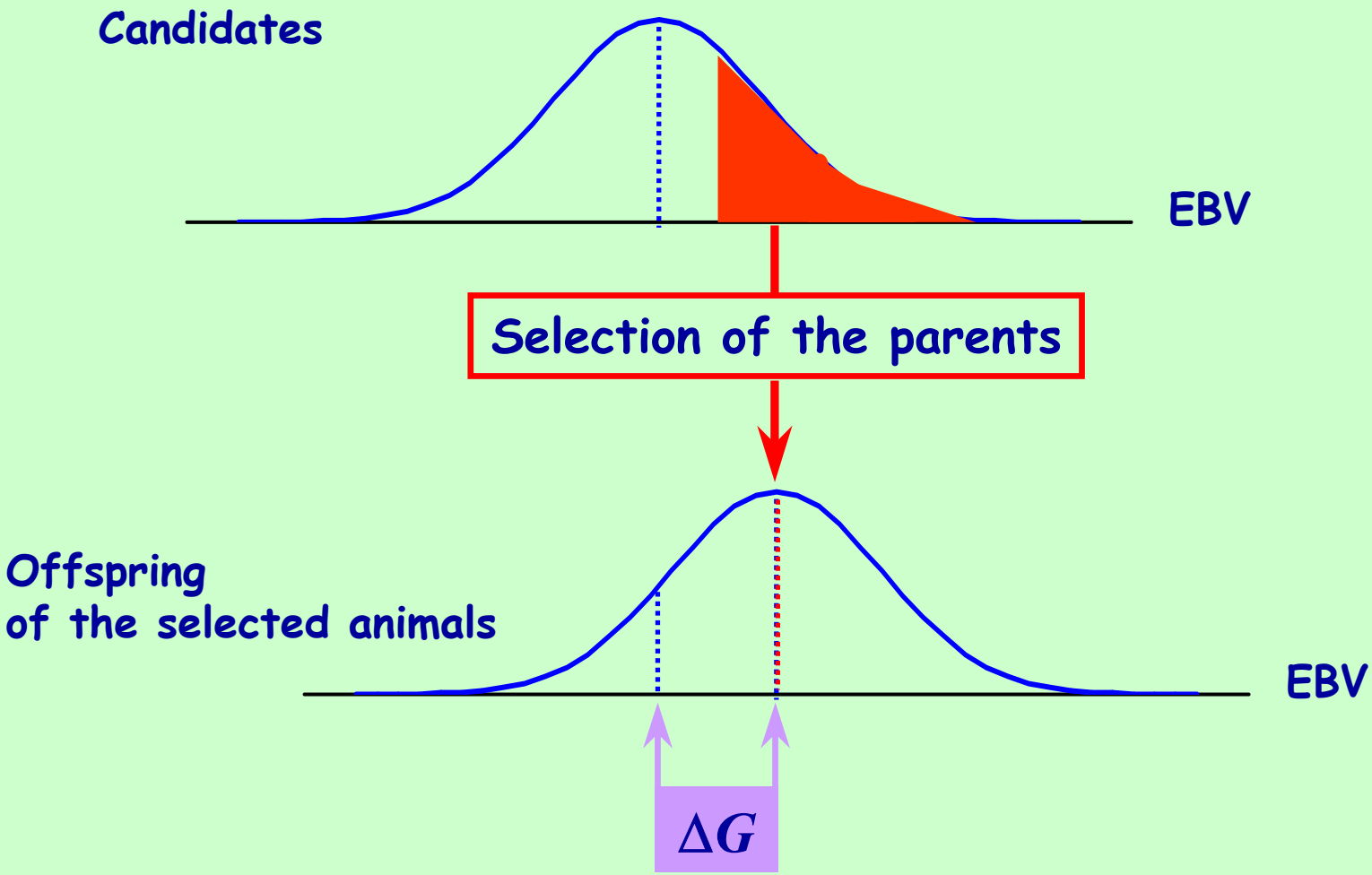
Summary

From one generation to the other



No genetic change

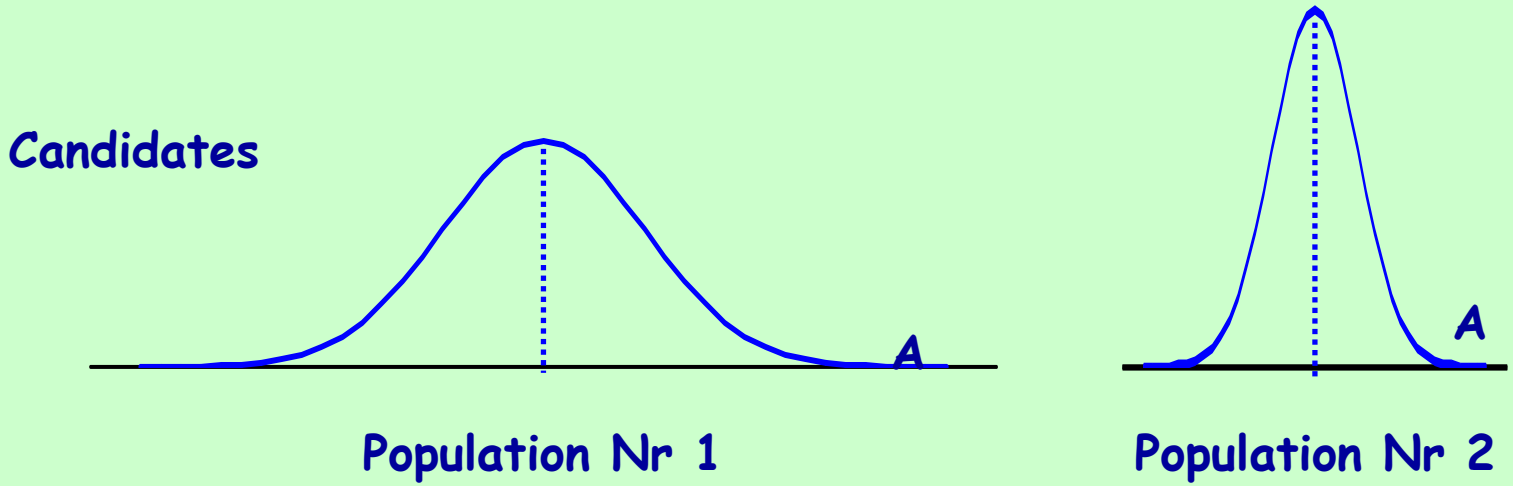
Representation of a selection step



Change in EBV → Genetic gain

Parameters of the genetic gain

1) The genetic variance of the trait



Population Nr 1

Population Nr 2

More progress is expected
within Population Nr 1 than within Population Nr 2

Parameters of the genetic gain

2) The selection criterion

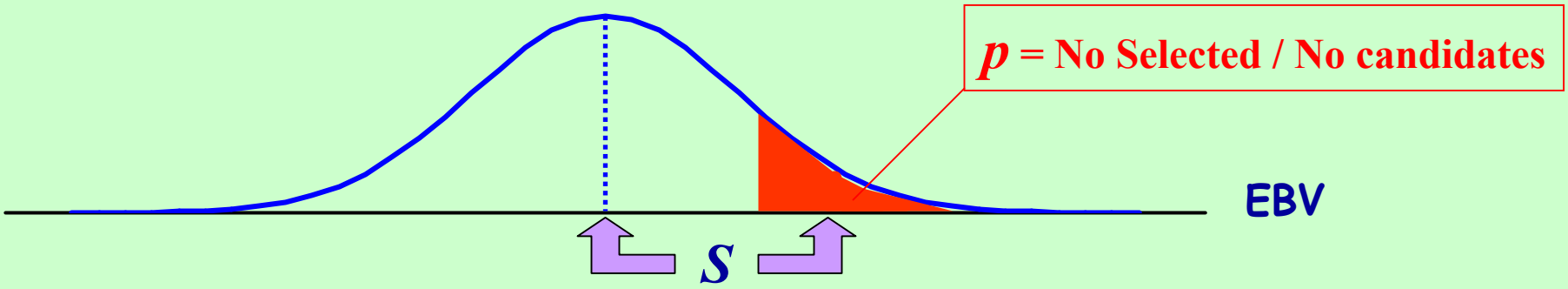
Corrélation between the selection criterion and the genetic value

Selection criterion = EBV → $R = [Rep]^{½}$

Previous chapter

Parameters of the genetic gain

3) The selection presure



Selection intensity:

i = standardised differential = S / EBVs standard deviation

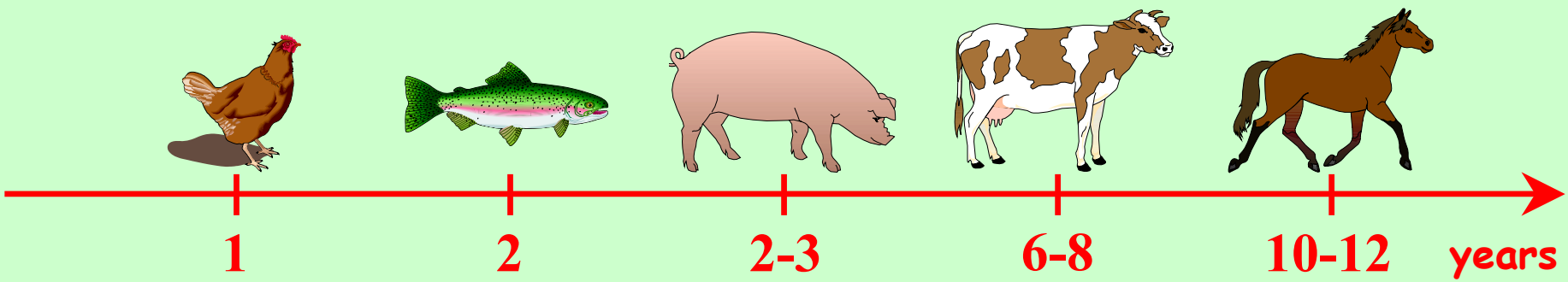
Chapter IV, Figure 10 and Table 11

Parameters of the genetic gain

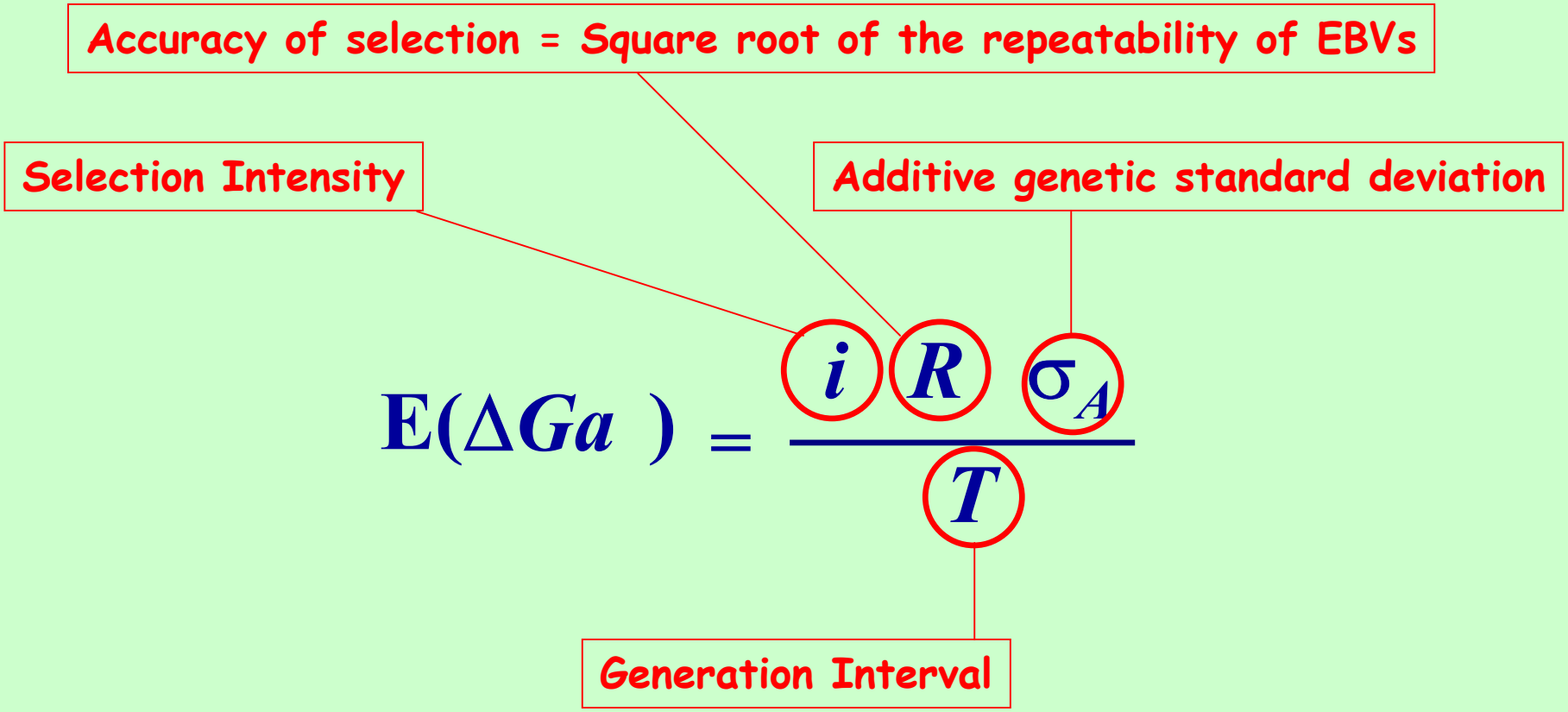
4) The duration of the process

From one generation to the other: Generation intervall

T = Average age difference between parents and offspring



Prediction of the annual genetic gain



The genetic gain and its parameters

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Summary

Mass selection

- individual selection, phenotypic selection -

Own Performance

i	*R*	*T*
+ + +	+ + / -	+ + / -

Main advantages:

Easiness, low cost → May be applied to large numbers of animals

Limits:

Traits for which performances exist in a single sex
Traits to be measured after slaughtering of the animal

Conclusion:

Sometimes suffisicent,
but often to be complemented with other methods

Pedigree selection

Performances (EBVs) of parents

i	R	T
-	- -	+ + +

Main advantages:

Earlyness (mating to procreate the next candidates)

Limits:

Low accuracy
Interest of the parents but little value of the far ancestors

Conclusion:

Necessary for a first selection, always to be complemented

Progeny testing

Average performance of a small sample of offspring

i	R	T
- -	+ + +	- - -

Main advantages:

High accuracy, overcomes the limits of mass selection

Limits:

Largely delays the selection decision
Requires a strong organisation and induces high costs

Conclusion:

Used only when a high accuracy is necessary (AI males, …)
after a first selection with other methods

Family selection

Average performance of sibs
(full- and half-sibs)

i	R	T
+ / -	+ / -	+ + / -

Main advantages:

Overcomes the limits of mass selection, with no delay

Limits:

Potential common environment within a family

Conclusion:

Complement to mass selection, species with large families

Complementary use of selection methods

In practice,

different informations and different selection methods

are combined

	Dairy AI bulls	Boars	Cocks Laying hen strains
Pedigree (mating to procreate candidates)	X	X	X
Own performance	Growth Sexual function	Growth, Muscle dev^{nt}	
Sibs		Growth, Muscle dev^{nt} Meat quality	Egg production
Offspring (Progeny testing)	Dairy traits Fonctional traits		

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Why to select several traits simultaneously

1) Concrete need to improve several traits for a given production

Meat production:

- Maternal traits: fertility, litter size, maternal behavior, …
- Growth, muscle or fat content of the carcass

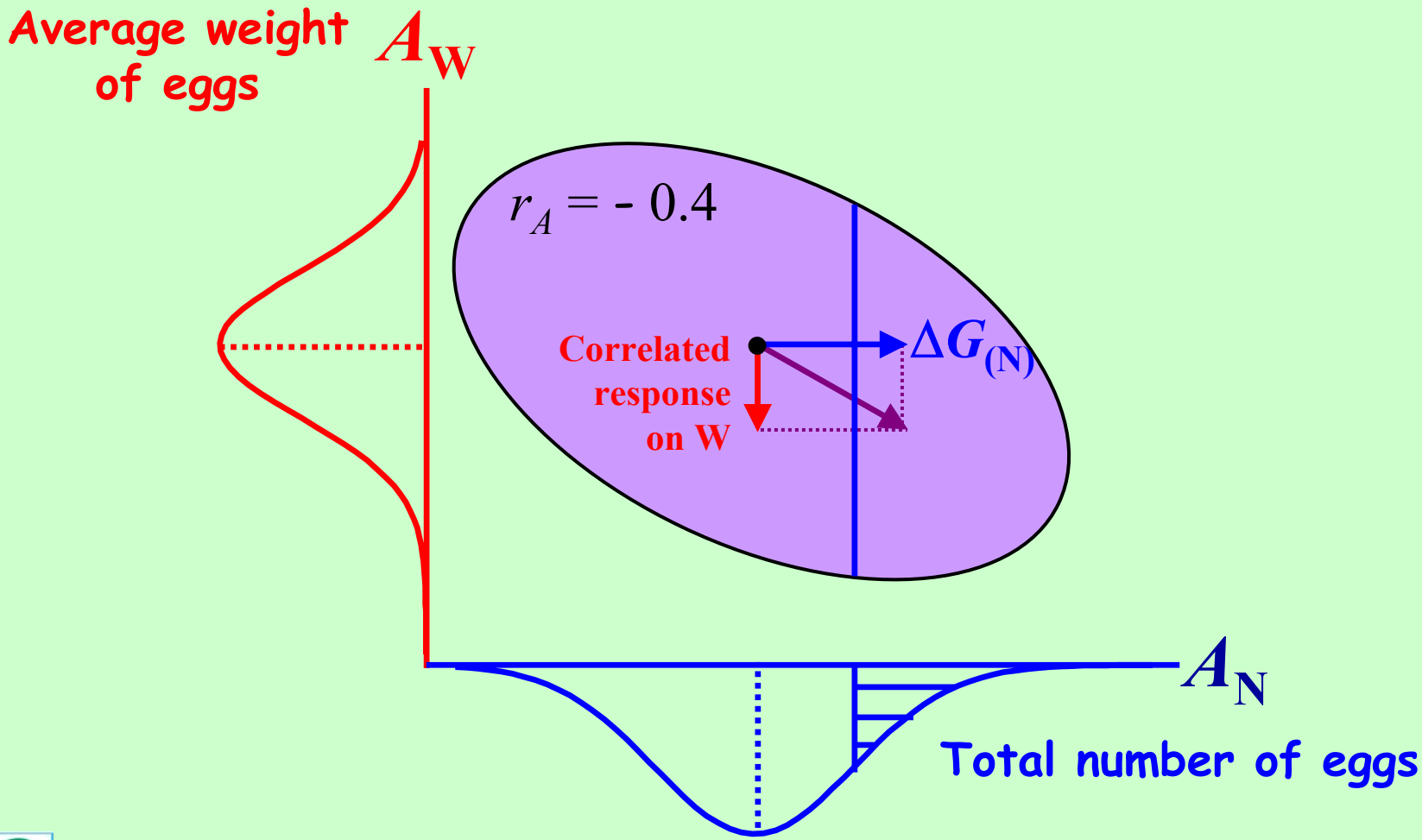
Milk production:

- Dairy traits
- Functional traits: fertility, disease resistance, morphology, longevity

2) Correlated responses, which may be defavourable due to negative correlations between traits

Correlated response to selection

The example of egg production



Prediction of the correlated response

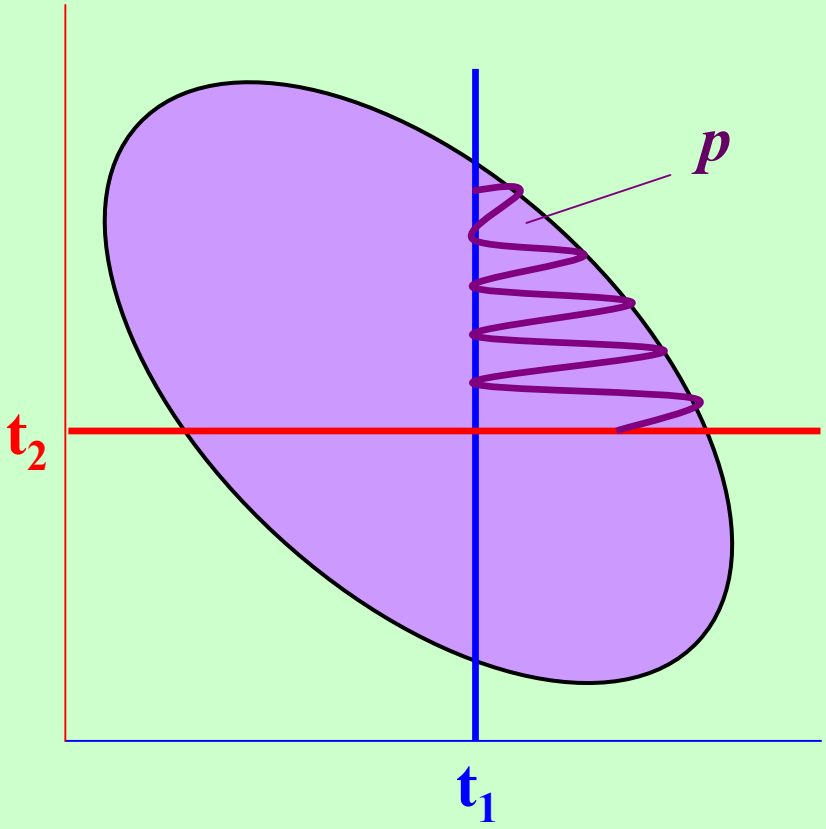
When selecting on a single trait,
one can predict the correlated response on any trait

The correlated is proportional to:

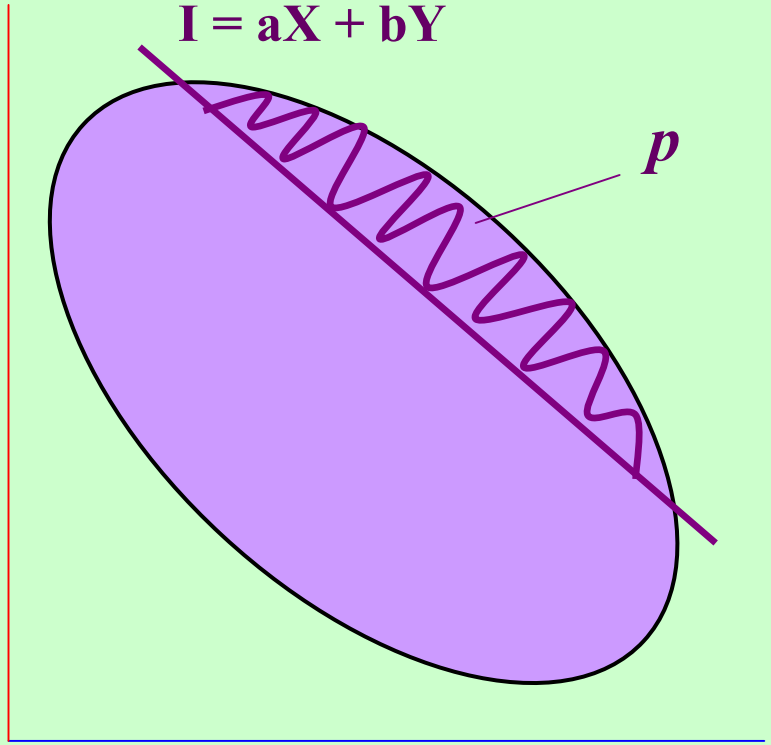
- The genetic correlation between both traits
- The expected genetic progress on the selected trait

$$E(\Delta G_2 | \Delta G_1) = r_{A[1,2]} \frac{\sigma_{A_2}}{\sigma_{A_1}} \Delta G_1$$

Methods for selecting two traits simultaneously



Independent thresholds



Linear Index

Comparison of the two methods

Independent thresholds

- More easy to apply
- Allows to make successive cullings
  → it is not necessary to evaluate all candidates for all traits
- Well suited when the different information are available at successive steps in the life of the animals

Linear index

- More efficient from a genetic point of view
- Requires that all candidates are evaluated for all traits
- More difficult to apply and more costly

In both cases: need for a clear hierarchy between traits

- To fix the different thresholds
- To fix the weights puted on the different traits

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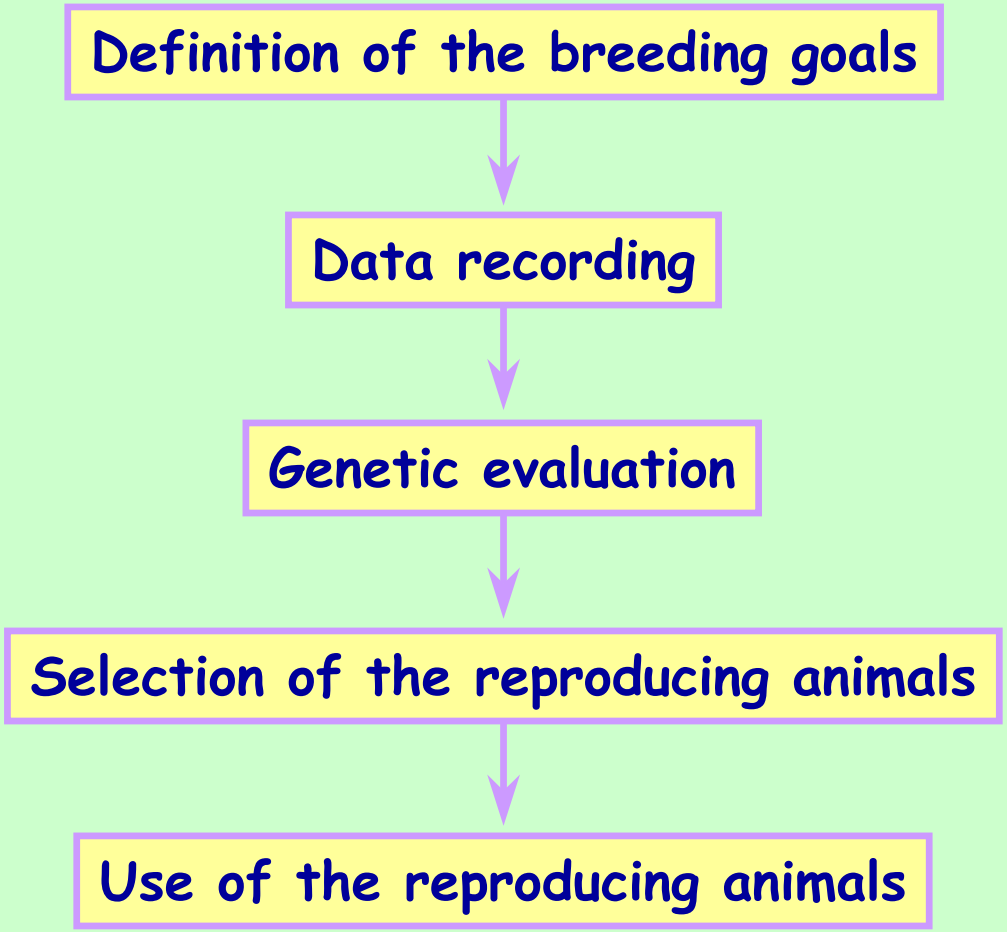
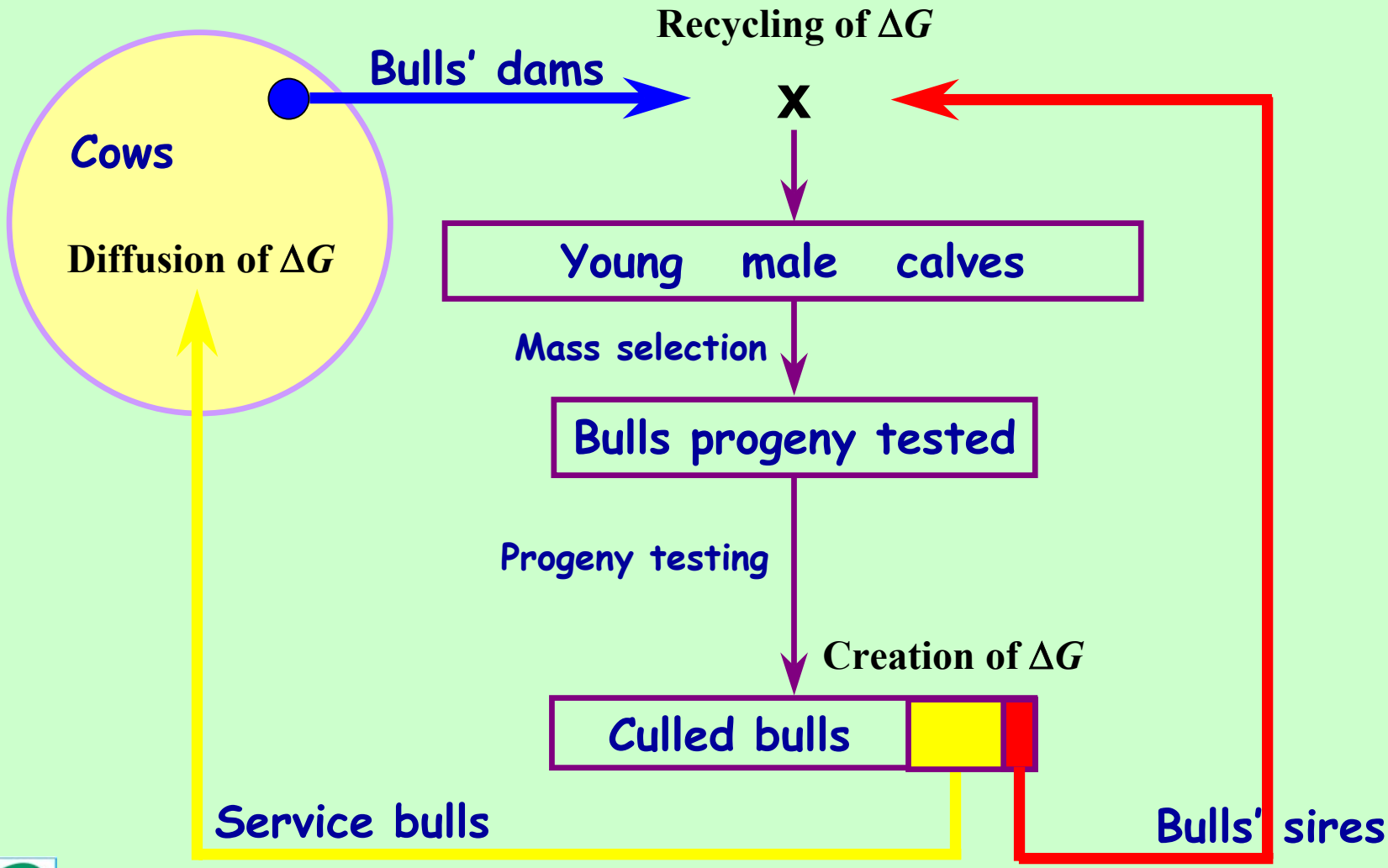
Different steps of a selection programme



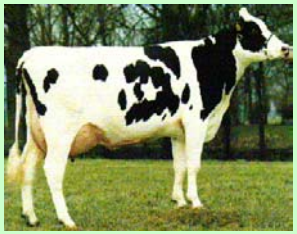
The use of the reproducing animals

The example of the AI bulls in dairy cattle

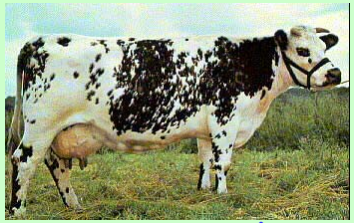


Realised genetic gain - dairy cattle in France -

Photos: SOPEXA, UPRA Abondance

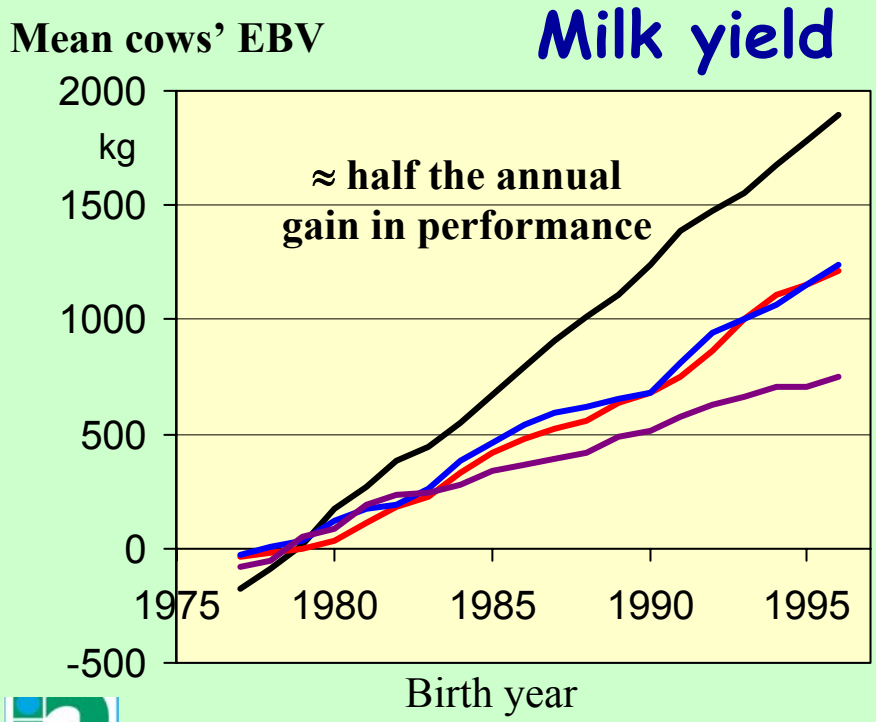

Holstein

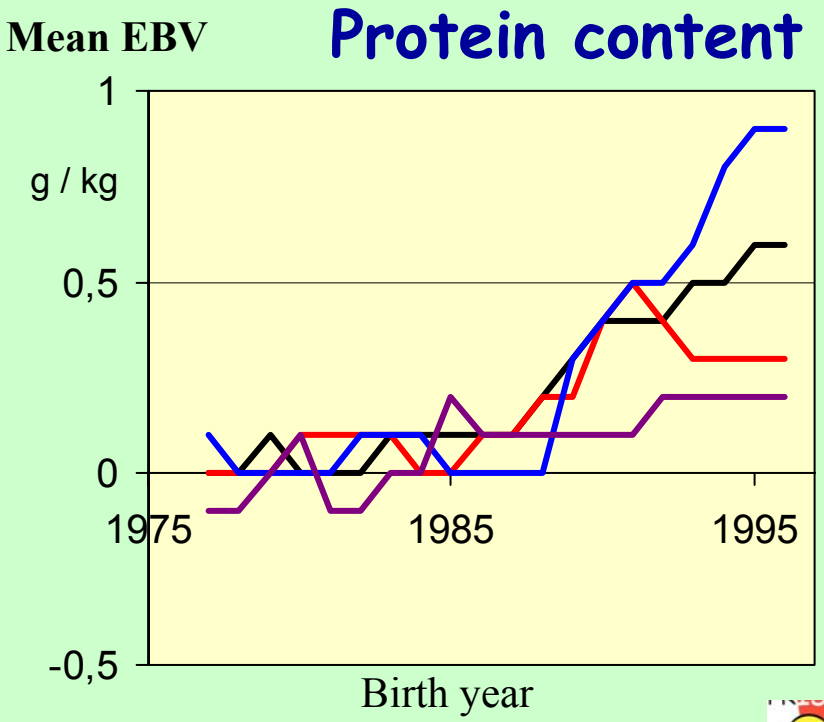

Montbéliarde


Normande


Abondance

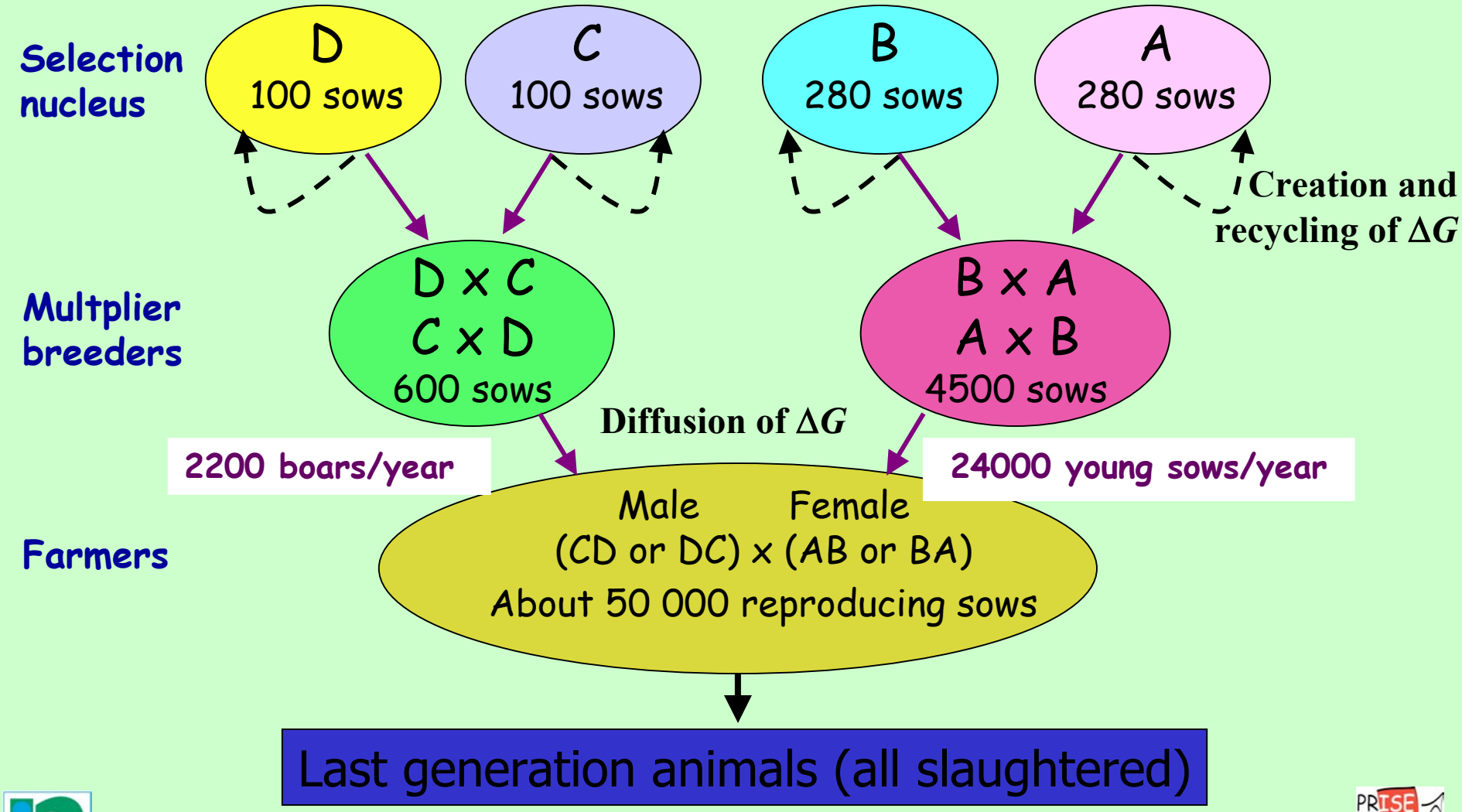
Source: INRA-Institut de l'Elevage





The use of the reproducing animals

The example of the pig production (from J.P. Bidanel, INRA)



Summary

The efficiency of seelction depends on parameters on which some constraints exist

Interest of combining different selection methods (or different information for genetic evaluation)

It is possible to select simultaneously for several traits

Using reproducing animals: recycling and diffusion of ΔG

Usefulness of an organisation of selection